VOL. 4 NO. 23
December 15, 1979

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ABSTRACTS 54010-55924

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Volume 4, Number 23, December 15, 1979
ISSN: 0160-3604
CODEN: ERABDZ

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Published by the **Technical Information Center, Oak Ridge, Tennessee**
United States Department of Energy

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The Secretary of the U. S. Department of Energy has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 4, Number 23, December 15, 1979

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 55107, 55126

54010 (ORNL—5550) **Fossil energy program. Quarterly progress report for the period ending March 31, 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract W-7405-ENG-26. 257p. Dep. NTIS, PC A12/MF A01.

This quarterly report covers the progress made during the period January 1 through March 31 for the Oak Ridge National Laboratory research and development projects that are carried out in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. These projects are supported by the DOE Divisions of Fossil Fuel Processing, Fossil Fuel Utilization, Fossil Fuel Extraction, Systems Engineering, Basic Energy Sciences, and Health and Environmental Research, and by the EPA Office of Research and Development through interagency agreement with the DOE.

54011 (ORNL/TM—6767) **Fossil Energy Program. Progress report for December 1978.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Mar 1979. Contract W-7405-ENG-26. 76p. Dep. NTIS, PC A05/MF A01.

This report - the fifty-third of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion progress development, material engineering, alkali metal vapor topping cycles, a coal equipment test program, an AFB coal combustor for cogeneration (CCC), engineering and support studies, process and program assistance, environmental assessment studies, magnetic beneficiation, and AFBC demonstration plant.

54012 (ORNL/TM—6815) **Fossil Energy Program. Progress report for January 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 67p. Dep. NTIS, PC A04/MF A01.

This report - the fifty-fourth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion progress development, material engineering, alkali metal vapor topping cycles, a coal equipment test program, an AFB coal combustor for cogeneration (CCC), engineering and support studies, process and program assistance, environmental assessment studies, magnetic beneficiation, and AFBC demonstration plant.

54013 (ORNL/TM—6829) **Fossil Energy Program. Progress report for February 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 65p. Dep. NTIS, PC A04/MF A01.

This report - the fifty-fifth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion progress development, material engineering, alkali metal vapor topping cycles, a coal equipment test program, an AFB coal combustor for cogeneration (CCC), engineering and support studies, process and program assistance, environmental assessment studies, magnetic beneficiation, and AFBC demonstration plant.

54014 (ORNL/TM—6886) **Fossil energy program. Progress report, March 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 74p. Dep. NTIS, PC A04/MF A01.

This report - the fifty-sixth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, and chemical research and development.

54015 (ORNL/TM—6923) **Fossil Energy Program progress report for April 1979.** (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 73p. Dep. NTIS, PC A04/MF A01.

This report - the fifty-seventh of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion progress development, chemical research and development, materials engineering, a coal equipment test program, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, an atmospheric fluidized bed combustor for cogeneration, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment.

54016 (ORNL/TM—6928) **Fossil Energy Program progress report for May 1979.** (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract W-7405-ENG-26. 92p. Dep. NTIS, PC A05/MF A01.

This report - the fifty eighth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, and chemical research and development.

54017 (ORNL/TM—6997) **Fossil Energy Program progress report for June 1979.** (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 77p. Dep. NTIS, PC A05/MF A01.

This report - the fifty-ninth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those of coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, and chemical research and development.

PROCESSING

CARBONIZATION

REFER ALSO TO CITATION(S) 54099

54018 (DOE/EIA—0121(77-78)) **Coke and coal chemicals in August 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 68p. NTIS, PC A04/MF A01.

Coke production is given by month from August 1977 to July 1978. Data are also given for coke stock on hand, bituminous coal carbonized, etc. (LTN)

54019 (DOE/EIA—0123(76)) **Distribution of oven and beehive coke and breeze in 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 25p. NTIS, PC A02/MF A01.

In 1976 shipments of coke produced in the US reached 61 million tons, up from 57.3 million tons in 1975. Shipments within the US in 1976 totaled 60.8 million tons, almost 7% higher than the 57 million tons shipped during the previous year. Coke exports totaled 292,000 tons, down from 318,000 tons in 1975.

54020 **Pipeline charging of coal into coke oven.** Bugajski, F.H.; Patel, J.G. (to Inland Steel Company). US Patent 4,165,260. 21 Aug 1979. Filed date 29 Dec 1976. 10p.

Coal mixed with steam is carried through a pipeline to a coke oven where the mixture is introduced through an opening in the oven top directly downwardly into the oven at a location remote from the exhaust outlet in the top of the coke oven.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 54041, 54047, 54048, 54082, 54090, 54092, 54140

54021 (CONF-780903—, pp 32-41) **Hot gas desulfurization with gasifier ash sorbents.** Schrodt, J.T. (Univ. of Kentucky, Lexington). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

Four gasifier coal ashes containing 5 to 23 wt % iron oxide have been used in small, fixed beds to sorb the gaseous sulfur components selectively from hot, synthesized, low-Btu fuel gas. Results show sulfide removal efficiencies in excess of 99% and sorption capacities of up to 400 grains of sulfide per pound of ash. Spent ashes, regenerated up to 20 times, show cyclic use improves the ash capacities and the process efficiency. Desulfurization data have been used to evaluate rate parameters in two models developed to simulate the process steps dynamically. The kinetic gas-film and pore-diffusion gas-film models are both needed to describe the desulfurization process over the full range of operation. Computer simulation of an adiabatic fixed-bed process predicts the temperature and concentration of hydrogen sulfide and the availability of unreacted iron oxide as a function of time and position in the bed. For the regeneration phase of the process, the program will predict the temperature and concentrations of oxygen and unreacted ferrous sulfide. This process will offer a superior alternative to low-temperature desulfurization processes. 10 figures, 3 tables.

54022 (LBL—9386) **Coal desulfurization via chemical leaching with aqueous solutions of sodium sulfide and polysulfide.** Mesher, J.A.; Petersen, E.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 88p. Dep. NTIS, PC A05/MF A01.

Thesis.

The objective of this work has been the development of a novel process for coal desulfurization which would surmount the difficulties and generally undesirable characteristics of already proposed or existing processes. Toward this end, a process was conceived whereby sulfur constituents would be leached from slurried coal by aqueous solutions of sodium monosulfide and polysulfide. Use of these solutions was suggested by published findings which indicated that they would be effective in removing both inorganic and organic sulfur from coal upon treatment of the latter at room temperature and pressure. In sharp contrast to claims made in the literature, our experimental results demonstrated that sodium disulfide solutions are not effective in desulfurizing coal. Conclusions of a more positive nature have also been drawn. First, the regeneration scheme developed herein, being far superior to existing proposals for such regeneration, should be applied to those systems where polysulfides may, in fact, be effectively used for desulfurization (i.e., of oil). Secondly, data gathered suggest that the use of aqueous sodium disulfide should be further investigated as the basis for an analytical tool by which the elemental sulfur content of coals may be determined. (LTN)

54023 **Process for removing sulfur from coal.** Anthony, D.B.; Marse, A.V. (to Standard Oil Co.). US Patent 4,162,898. 31 Jul 1979. Filed date 31 Mar 1978. 6p.

Inorganic and organic sulfur are removed from coal by contacting the coal with gun blueing solution, namely an aqueous soluion of sodium nitrite, sodium nitrite and sodium hydroxide. This is accomplished at comparatively low temperatures and purposes.

54024 **Coal deashing process having improved solvent recovery techniques.** Rhodes, D.E. (to Kerr-McGee Corp.). US Patent 4,162,956. 31 Jul 1979. Filed date 20 Mar 1978. 12p.

An improved coal deashing process wherein coal is mixed with a coal liquefaction process solvent, solubilized and flashed to provide a prepared mixture and the prepared mixture is mixed with a deashing solvent to produce a feed mixture. Thereafter, the feed mixture is separated in a first separation zone into a first heavy fraction comprising insoluble coal products and a first light fraction comprising soluble coal products and solvents. The first light fraction is recovered and a second portion of the deashing solvent is mixed with the first light fraction prior to introduction into a second separation zone wherein an improved separation occurs to produce a second light fraction comprising the solvents and a second heavy fraction comprising the soluble coal products which is recovered. The second light fraction is withdrawn and separated in a third separation zone into a third heavy fraction comprising the liquefaction process solvent for recycle to aid in solubilization of the coal and a third light fraction comprising the deashing solvent for recycle to aid in the production of the feed mixture.

GASIFICATION

REFER ALSO TO CITATION(S) 54074, 54168, 54273, 54752

54025 (CONF-780903—, pp 78-94) **Sampling of process streams for physical and chemical characterization of respirable aerosols.** Newton, G.J.; Carpenter, R.L.; Yeh, H.C.; Weissman, S.H.; Hanson, R.L.; Hobbs, C.H. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

Similar aerosol sampling systems have been designed, constructed, and used to obtain respirable samples from process streams of two advanced coal utilization technoloiges. An experimental low-Btu stirred-bed coal gasifier (LBTUG) and an experimental atmospheric-pressure fluidized-bed coal combustor (FBC) were studied. In both cases the sampling system withdrew a sample from the process stream, cooled and diluted it, and transported the aerosol produced to a sampling chamber. In all cases the sampling system collected only respirable-sized particles (<10 μm). A number of aerosol sampling devices were used. In addition to filter samples for bulk aerosol properties, cascade impactors were used to obtain samples that yielded data on size distribution and chemical composition as a function of particle size. The Lovelace Aerosol Particle Separator, a type of aerosol centrifuge, was used to obtain size-differentiated samples for electron microscopy and comparison with aerodynamic-sized particles for determination of effective particle densities. Point-to-plane electrostatic precipitators were also used to obtain samples for transmission and scanning electron microscopy as well as x-ray energy spectroscopy. Tenax-GC samples were used to determine vapor-phase hydrocarbons in the aerosol. In a collaborative program with the Morgantown Energy Technology Center, aerosols at two locations in the LBTUG process streams and four positions along the FBC exhaust stream have been sampled. Both coal-use technologies produce respirable-sized particles that are significantly different form those produced by conventional pulverized coal combustors. 12 figures, 12 tables.

54026 (CONF-790802—42) **Feasibility study of prestressed concrete pressure vessels for coal gasifiers.** Oland, C.B.; Greenstreet, W.L.; Callahan, J.P. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The use of prestressed concrete pressure vessels (PCPVs) for gasifiers in coal conversion systems has been examined. Conceptual designs for commercial-sized vessels were developed based on an output of 2.64×10^8 MJ/day for the HYGAS process gasifier and 1.32×10^8 MJ/day for the Synthane process gasifier. Circular cylindrical configurations were employed for the single-cavity vessels. Geometry of the liners was essentially the same as proposed for the commercial steel vessel in both cases. Liners for both gasifiers are protected from the process temperature and the deleterious effects of the process media by refractory lining systems. Two liner designs were developed for each type of gasifier based on a hot-liner system and a cold-liner system. The hot-liner is designed to operate at a temperature above the dew point of the process fluid. Insulating concrete is used between the steel liner and the structural concrete.

Anchorage is provided by steel anchor studs welded to the liner. The studs extend through the insulating concrete and are embedded into the structural concrete. The refractory is anchored by stainless steel to the inside of the steel liner. Finned tubes through which cooling water is circulated to remove excess heat are located between the insulating concrete and structural concrete. The cold liner, which is restricted to temperatures below the dew point of the process fluid, was selected as the backup design. Each vessel is posttensioned by circumferential strand windings which are confined and anchored in steel-lined precast concrete channels on the outside surface of the PCPV. Linear tendon clusters which are housed in steel ducts provide the axial prestressing. Results of these studies show that the use of prestressed concrete vessels in applications where large, heavy-walled, steel vessels are required is both technically and economically feasible. The advantages of concrete over steel vessels for gasifiers are directly related to vessel size.

54027 (CONF-790917—4) **Reactivity of TRI-GAS char in a fluidized-bed reactor.** Colaluca, M.A.; Mahajan, K.; Paisley, M.A. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). 1979. Contract ET-78-C-01-2798. 13p. Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

A two-phase fluidized-bed model can be used to predict the conversion observed in the char-steam gasification reaction in a 5.08-cm fluidized-bed reactor. The best fit of the experimental data was obtained using the K and L model to calculate the mass exchange between the bubble and particulate phases.

54028 (DOE/EDP—0047) **Environmental development plan: underground coal gasification.** (Department of Energy, Washington, DC (USA)). Sep 1979. 76p. Dep. NTIS, PC A05/MF A01.

The possibility that groundwater quality may be adversely affected by UCG is a major concern. Early tests indicate that some of the groundwater pollution due to UCG is confined to an area adjacent to the gasified zone and the cleansing properties of the surrounding coal may serve as a natural contaminant control system. Ground subsidence is another major concern. Subsidence could cause disruption of aquifers, surface disturbance, and loss of product gas through cracks to the surface. The DOE program, therefore, includes studies to predict subsidence and its effects through modeling in conjunction with extensive field measurements. Degradation of air quality is also a significant concern particularly with respect to emissions through cracks and fissures resulting from anticipated subsidence. Potential hazards to the worker exist including the inadvertent release of gas through cracks in the ground surface and worker safety associated with the sudden collapse through subsidence. Environmental regulations which will most directly affect the UCG program include the Federal Water Pollution Control Act, the Safe Drinking Water Act, and the Clean Air Act. These regulations will impact upon pollution control requirements, and potential siting of facilities. No specific emission or effluent requirements currently address UCG, but current efforts to characterize potential groundwater contamination and air emissions will form the basis for future guidelines.

54029 (DOE/NASA/2674—79/6) **Performance characteristics of a slagging gasifier for MHD combustor systems.** Smith, K.O. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1979. Contract EF-77-A-01-2674. 50p. Dep. NTIS, PC A03/MF A01.

The performance of a two-stage, coal combustor concept for MHD systems was investigated analytically. The two-stage MHD combustor comprises an entrained flow, slagging gasifier as the first stage and a gas phase reactor as the second stage. The first stage was modeled by assuming instantaneous coal devolatilization and volatiles combustion and char gasification by CO_2 and H_2O in plug flow. Heterogeneous surface reaction rates were determined from experimental data in the literature. Gasifier heat loss was treated parametrically. Slag effects were not considered. The second-stage combustor was modeled assuming adiabatic instantaneous gas phase reactions. Of primary interest was the dependence of char gasification efficiency on first-stage particle residence time. The influence of first-stage stoichiometry, heat loss, coal moisture, coal size distribution, and degree of coal devolatilization on gasifier performance and second-stage exhaust temperature was determined. Performance predictions indicate that particle residence times on the order of 500 msec would be required to achieve gasification efficiencies in the range of 90 to 95%. The use of a finer coal size distribution significantly reduces the required gasifier residence time for acceptable levels of fuel-use efficiency. Residence time requirements are also decreased by increased levels of coal devolatilization. Combustor design efforts should maximize devolatilization by minimizing mixing times associated with coal injection.

54030 (FE—1545-TK-14) **Test program for low-Btu gasification of coal for electric power generation. Final report R and D Task 14 (Phase 1).** Simon, J.J. (Combustion Engineering, Inc., Windsor, CT (USA)). Nov 1977. Contract EX-76-C-01-1545. 100p. Dep. NTIS, PC A05/MF A01.

A test program was developed to demonstrate the capability and suitability of the process and equipment to produce a low-Btu gas of the predicted composition, heat content and cleanliness from the design coal. This program included both parameter operation and sustained operation periods to provide the design information to enable scale-up of the equipment to commercial-size designs.

54031 (FE—2469-35) **Experimental program for the development of peat gasification. Interim report No. 6: hydrogasification and fluidized-bed tests as of September 30, 1978.** (Institute of Gas Technology, Chicago, IL (USA)). Mar 1979. Contract EX-76-C-01-2469. 100p. Dep. NTIS, PC A05/MF A01.

The results of tests with the Minnesota peat and laboratory-scale tests with North Carolina and Maine peats are presented. Thirty-five tests were conducted in the hydrogasification PDU with Minnesota reed sedge peat to determine the effects of temperature, hydrogen partial pressure, residence time, and the presence of carbon oxides (in synthesis gas) on the product distribution and yields. The tests were conducted at coil temperatures of 800° to 1550°F, hydrogen partial pressures of 0 to 535 psia, and residence times of 3 to 22 seconds. The peat flow rates were as high as 250 times those in the laboratory-scale tests. The results agree reasonably well with the laboratory-scale data. Eighteen gasification tests were conducted in a 6-inch-diameter fluidized-bed reactor with steam and oxygen. Both Minnesota peat char and raw peat were gasified. The objectives were to determine the effects of temperature, pressure, and steam/feed carbon mole ratio on the gasification characteristics of peat and peat char. The tests were conducted at pressures of 350 to 535 psia, average bed temperatures of 1700° to 1900°F, steam/feed carbon mole ratios of 0.7 to 3.9, and fluidization velocities of 0.4 to 1.0 ft/s. Carbon conversions as high as 98% were achieved. The effects of temperature and fluidization velocity on the sintering characteristics of peat were also determined. Twenty-three tests were conducted in the thermobalance with chars of peats from North Carolina and Maine at various pressures and temperatures and with steam/hydrogen mixtures and synthesis gas to determine gasification characteristics of these peats and to develop kinetic models similar to those developed for Minnesota peat.The gasification characteristics of these peats are quite similar to those of Minnesota peat. (LTN)

54032 (LA—7592-MS, pp 6.1-6.19) **Preliminary design of a catalyzed coal gasification system utilizing nuclear heat.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

This study assesses the applicability of a nuclear reactor as a source of process heat to assist in catalyzed coal gasification. The coal gasification chain design, overall energy balance, equipment design, and heat integration, overall results of energy calculation for integrated catalytic coal gasification system, and utilization of a nuclear reactor to drive the catalytic coal gasification system are discussed.

54033 (LA—7592-MS, pp 8.1-8.27) **Preliminary economic analysis of coal gasification using fission reactors to provide thermal energy.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

The economic viability of using thermal energy from nuclear fission for coal gasification is assessed. Sections are devoted to: a brief description of fission power plant characteristics; a description of coal gasification requirements; and an economic analysis of nuclear fission for coal gasification.

54034 (MTR—79W00160) **Assessment of long-term research needs for coal-gasification technologies.** Penner, S.S. (Mitre Corp., McLean, VA (USA). METREK Div.). Apr 1979. Contract ER-78-C-01-6335. 207p. Dep. NTIS, PC A10/MF A01.

The Fossil Energy Research Working Group (FERWG) was commissioned in April 1978 by The MITRE Corporation at the request of the Department of Energy. The purpose was to provide an independent assessment of critical research areas that affect long-term development of coal-gasification technologies. This report summarizes the findings and research recommendations of the FERWG.

54035 (ORNL/TM—6969) **Structural integrity of vessels for coal conversion systems.** Canonico, D.A. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

The integrity of a coal conversion system need not be compromised by material considerations in design or fabrication. The ASME and ANSI Codes assure the structural integrity of the large pressure vessels and piping when they are placed into service. Imposing additional requirements, such as increased impact toughness, will further assure the reliability and safety of the Code-fabricated vessel. Incorporating in-service surveillance as part of the operational plan will ensure the integrity of the pressure-containing components for the anticipated service life.

54036 (PMD—79-1794) **Industrial Fuel Gas Demonstration Plant Program. Quarterly progress report, April 1-June 30, 1979.** (Memphis Light, Gas and Water Div., TN (USA)). 13 Jul 1979. Contract EF-77-C-01-2582. 38p. Dep. NTIS, PC A03/MF A01.

The objective of the Industrial Fuel Gas Demonstration Plant Program is to demonstrate the feasibility of converting agglomerating and high sulfur coal to clean fuel gas and utilizing this gas in a commercial application. Specific objectives are to conduct process analysis, design, construction, testing, operation, and evaluation of a plant based on the U-Gas process for converting coal to industrial fuel gas. The most significant problem now facing the program is the funding problem. Current month by month funding has maintained the schedule, but full resolution is required at the earliest possible date. The Industrial Team has provided to DOE a number of packages covering estimated costs to complete, scope additions/deletions, and miscellaneous items. The total modification amount was verbally agreed to with draft modification documents prepared. However, DOE has requested new submittals which summarize the request packages. These Requests for Additional Funds have been submitted. (LTN)

54037 (PMD—79-1829) **Synthesis gas demonstration plant program. Phase I. Quarterly technical progress report, 1 April 1979-30 June 1979.** Simpson, M.R. (Grace (W.R.) and Co., Memphis, TN (USA)). 1979. Contract EF-77-C-01-2577. 27p. Dep. NTIS, PC A02/MF A01.

Phase I of the project is 90.9% complete as of the end of the current reporting period. Contributing to this degree of completion were the finalization of all activities associated with the conceptual design of the Commercial Plant. The Demonstration Plant design is estimated to be 91.5% complete, with initial issues of all technical documentation (process schematics, flow diagrams, equipment specification sheets, etc.) having been completed. Three particularly important accomplishments which occurred during the quarter were the development of the draft capital cost estimate for the Demonstration Plant and the submittal to DOE of both the Draft Environmental Report and the Allocation Method. Analysis of the capital estimate, particularly as regards compliance with the Allocation Method, and development of the operating cost estimate have been initated. Phase II planning activities (Materials and Licenses, and Demonstration Plant Construction and Operation Plan) progressed with development of plans for obtaining water, electrical power, and chemicals, proprietary licenses, procurement plan, safety plan, permitting plan, Phase II schedule and staffing plan.

54038 (SAN—1429-36) **Molten Salt Coal Gasification Process Development Unit. Quarterly technical progress report No. 9, April-June 1978.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 18 Jul 1978. Contract EF-77-C-03-1429. 24p. Dep. NTIS, PC A02/MF A01.

The project includes the design, construction, and operation of a PDU which will convert one ton of coal per hour into low-Btu gas. Construction work at the site was completed and start-up activities initiated. An organized turnover procedure was followed to cover the transition from construction to start-up phases. Checkout and operating procedures were prepared and are being followed during actual start-up of plant hardware. Some minor discrepancies and proposed plant improvements were noted during the initial inspection and checkout activities, and these items were reviewed and compiled for resolution. A safety analysis was performed for the PDU and the report issued in draft form.

54039 (TID—29303) **Coal processing for fuel cell application. Task I: the reaction of char with CO_2 and H_2O in entrained flow gasifiers. Task report, July 1-October 31, 1978.** Lewis, P.F.; Finson, M.L. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Research Center). Nov 1978. Contract EW-78-A-21-8450. 26p. Dep. NTIS, PC A03/MF A01.

This report attempts to verify observations made on entrained flow gasifiers by using data gathered from controlled laboratory experiments to evaluate the degree to which heterogeneous chemical reactions other than oxidation could play a role in entrained flow gasifiers. Because of the difficulty of obtaining diagnostic information on the details of the phenomena taking place inside the high temperature section of entrained flow gasifiers, these data are on the fundamental reaction of CO_2 and H_2O with solid carbon and have been incorporated into a model of the reaction of porous char particles. The char particle reaction model includes a description of the porous structure of chars, the variation of the char structure with reaction, and accounts for such limiting processes as external boundary layer diffusion, Knudsen and continmum diffusion in the pores, and various chemical reactions. The conclusions of this study are three-fold; the reaction of char with CO_2 and H_2O is rapid enough at temperatures above 1600°K to play an important role in the gasification of particles less than about 50μ in diameter, in a time less than one second; the calculated rates of the heterogeneous water gas shift reaction are in qualitative agreement with a water gas shift freeze temperature of about 1400°K, as experimentally observed; and the magnitude of the rates, indicate that catalysis of the water-gas shift reaction by mineral matter may be necessary to explain the observed shift freeze temperature.

54040 (TID—29336) **Coal processing for fuel cell application. Task II: kinetics of contaminants and additives in entrained gasification. Task report, July 1-September 30, 1978.** Kothandaraman, G.; Lewis, P.F. (Physical Sciences, Inc., Woburn, MA (USA)). Oct 1978. Contract EW-78-A-21-8450. 33p. Dep. NTIS, PC A03/MF A01.

Chemical kinetic rate descriptions have been developed for relevant coal gasification species including compounds of nitrogen, sulfur, chlorine, sodium and potassium. Equilibrium calculations have also been performed, which show that the oxides of chlorine and nitrogen are present in negligible amounts at equilibrium under the gasifier conditions.

54041 (TID—29337) **Coal processing for fuel cell application. Task IV: chemistry of hot gas cleanup of H_2S by calcium-based sorbents. Task report, July 1-September 30, 1978.** Rawlins, W.T.; Simons, G.A. (Physical Sciences, Inc., Woburn, MA (USA)). Oct 1978. Contract EW-78-A-21-8450. 15p. Dep. NTIS, PC A02/MF A01.

Literature relating to the reaction of H_2S with limestone and dolomite has been reviewed and the most significant articles are discussed. Equilibrium calculations indicate an optimum thermodynamic limit of $(H_2S)/(H_2O) \approx 10^{-3}$ for a typical fluidized bed gasification process using limestone or dolomite at temperatures of 1000 to 1200K; thus, the minimum H_2S level which can be attained in the gasifier is probably near 100 ppm. Detailed kinetic investigations have shown that the reactivity of calcined stone is optimized by using a prous parent rock and calcining in a CO_2-rich atmosphere (as is present in the gasifier system). Kinetic studies of the H_2S-dolomite reaction indicate that high sorbent efficiency can be achieved by judicious choice of temperature and CO_2 mixing ratio. The information obtained from this literature survey can be used as input for further efforts. First, detailed interpretation and analysis of the existing data base will be carried out, with particular attention to the work of Borgwardt and Harvey, Hartman and Coughlin, and Ruth et al. The principle effort will be to interpret the results of these investigators within the framework of a conceptual model of the evolution of the porous structure of solid reactants and products. Second, these modeling concepts will be used to extrapolate the existing data base from laboratory conditions to the gasifier/fuel cell plant scenario in order to determine the feasibility of the process. Third, the results of the data interpretation and feasibility analysis will be used to identify problem areas and to define an experimental effort directed towards the solution of these problems.

54042 (UCRL—81934) **Field performance of underground coal gasification.** Stephens, D.R.; Brandenburg, C.F.; Burwell, E.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Apr 1979. Contract W-7405-ENG-48. 7p. (CONF-791108—2; CONF-790803—46). Dep. NTIS, PC A02/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

Underground coal gasification (UCG) offers a relatively low cost, environmentally sound method to produce clean fuels from coal. The coal resource for UCG is vast, widely distributed and is unminable by present-day techniques. Field tests to date have confirmed the potential economical and environmental advantages. Major milestones of the DOE UCG program include: Gasification with air producing low Btu gas (165 Btu/scf) at a production rate of 8.5×10^5 SCFD. This experiment was conducted by the Laramie Energy Technology Center and was in continuous operation for 55 days. Steam/oxygen gasification produced medium Btu gas (263 Btu/scf) at 1.7×10^6 SCFD. This test was carried out by the Lawrence Livermore Laboratory and was in continuous operation for 58 days of air gasification with a scheduled 2 day oxygen test. The results of the field testing have been very encouraging. The ultimate objective of the DOE program is to develop sources of commercial gas for SNG and power generation by 1987. A number of key issues must be resolved to move the technology into the commercial sector: demonstration of reliable link at bottom of the coal seam, control of water influx, minimization of gas losses, subsidence control, process control with good gas quality, environmental control, technology transfer to industry, and larger multimodule tests to demonstrate control of interacting modules. (LTN)

54043 **Apparatus for the gasification of carbonaceous material.** Kaimann, W.; Brachthaueser, K.H. (to Projektierung Chemische Verfahrenstechnik GmbH). US Patent 4,165,971. 28 Aug 1979. Priority date 19 May 1976, German, Federal Republic of (F.R. Germany), 4p.

A process and apparatus for material processing, in particular for producing gas from carbon-containing material, are disclosed. Feed material comprising particulate material is continuously formed into briquettes and is simultaneously introduced into a processing compartment. The feed material is formed into briquettes by one or more pressure wheels forcing the material through channels in a die.

54044 Process and apparatus for gasifying granular coal under superatmospheric pressure. Rudolph, P.; Becker, P. (to Metallgesellschaft Aktiengesellschaft). US Patent 4,165,970. 28 Aug 1979. Priority date 16 Aug 1977, German, Federal Republic of (F.R. Germany), 4p.

An improvement in a known process and apparatus for gasifying coal with water vapor and oygen under pressure and at elevated temperature wherein coal is dropped onto a grate within a reactor supplied with gasifying agent from below, product gas being withdrawn above. In accordance with the invention an annular gas space through which product gas is withdrawn. The annular space surrounds the top of the coal bed so the coal is preheated thereby. The wall is provided with apertures so that at least 20% of the product gas enters the annular space by traversing that part of the coal bed surrounded by the wall. This results in reduced product gas velocity and entrainment of coal dust.

LIQUEFACTION

REFER ALSO TO CITATION(S) 54024, 54035, 54055, 54085

54045 (CONF-780903—, pp 102-115) **Trace elements in the solvent refined coal processes, SRC I and SRC II.** Filby, R.H.; Khalil, S.R. (Washington State Univ., Pullman). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

Knowledge of the behavior and fate of trace elements in the Solvent Refined Coal processes (SRC I and SRC II) from coal liquefaction is important for two broad reasons (a) the effects of trace elements on the liquefaction process itself and on the products; and (b) the environmental aspects of trace element transformations and releases during liquefaction and disposal of wastes. Analytical data was included for trace elements in both SRC I and SRC II processes. A comparison of trace elements in SRC I and SRC II products with other fossil fuels was discussed. In both SRC I and SRC II processes, water is produced as a reaction product in the hydrogenation of the coal, and it is also used as a quenching agent. These process waters contain trace metals from a number of possible sources in addition to H_2S and organic compounds soluble in water. The treatment process used in the SRC I and SRC II processes is flocculation with aluminum hydroxide, biodegradation of organic species, and then filtration through activated charcoal. The cencentrations of As, Sb, Hg, Se, Pb, Cd, Be, Co, Cr, Fe, Ni, Zn were measured. 2 figures, 21 tables.

54046 (FE—2514-M1) **Developmental research program for clean industrial and transportation fuels from coal.** Snell, G.J. (Lummus Co., Bloomfield, NJ (USA)). Mar 1978. Contract EF-76-C-01-2514. 60p. Dep. NTIS, PC A04/MF A01.

A coal liquefaction pilot plant facility originally designed for blocked continuous operations was modified for fully integrated continuous operation. This facility, after leak testing and mechanical debugging, was operated in a continuous and fully integrated manner with a coal paste feed consisting of 30 wt. % Illinois No. 6 coal. The presulfided 1/32″ extrudate nickel molybdate catalyst initially charged to the upflow expanded bed hydroliquefaction reactors was replaced with a 10-14 mesh presulfided spherical nickel molybdate catalyst following initial operations. Coal space rate limitations at recycle/fresh-feed ratios in the neighborhood of 0.8 - 1.4 with different catalyst shapes and sizes were determined. A severe pressure letdown valve erosion problem was observed during initial pilot plant operations. Cobalt molybdate catalyst, nickel molybdate catalyst and a developmental proprietary catalyst were evaluated in a separate continuous bench-scale unit. All catalysts were 1/32″ extrudates and a coal paste feedstock was used exclusively. Denitrogenation activity of the nickel molybdate and proprietary catalysts were found to be 15% and 18%, respectively, higher than the cobalt molybdate catalyst (Cyanamid 1442B). Since the nickel molybdate catalyst was of a commercially available type, the decision was made to utilize this catalyst for the immediate effort while investigations were pursued outside of the contract work to effect further improvements on the performance of the proprietary catalyst.

54047 (FE—2566-20) **Upgrading of coal liquids. Interim report: hydrotreating and fluid catalytic cracking of h-coal process derived gas oils.** Tan, G.; DeRosset, A.J. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Aug 1978. Contract EF-77-C-01-2566. 65p. Dep. NTIS, PC A04/MF A01.

The applicability of commercial UOP hydrotreating and fluid catalytic cracking (FCC) processes to distillate liquids derived from the H-Coal process was evaluated. The raw H-Coal atmospheric still bottoms were rerun in a laboratory column to remove heavy ends generated during storage. This operation also substantially reduced the contents of heptane insolubles, Conradson carbon, and steam jet gum. The rerun H-Coal atmospheric still bottoms (H-coal gas oil) were used to evaluate the relative hydrogenation activity of three UOP commercial catalysts. The UOP-DCB catalyst, which was found to have the highest hydrogenation activity, was employed in the H-Coal gas oil hydrotreating process variable studies. Fluid catalytic cracking of H-Coal derived distillate liquids was carried out over a commercial zeolite catalyst. Two sets of processing conditions were employed to catalytically crack each of these feedstocks. Results show that feed hydrogen content is a dominant factor on conversion and yield structure. Hydrotreating substantially improved the cracking characteristics of the H-Coal gas oil. As more hydrogen was added, the feed showed higher conversion and increased gasoline yield with reduced carbon deposition. In the range of conditions investigated, high octane gasolines were obtained. Cycle oils containing 650°F$^-$ distillate as high as 93 vol-% were generated. The lighter portions of the cycle oil, boiling between 400-650°F, are valuable components of distillate fuels and heating oils. It is concluded that with an appropriate degree of hydrotreatment the H-Coal process derived gas oil, or any other coal derived distillate of similar quality, can be readily processed into high quality gasolines by applying advanced commercial fluid catalytic crackingtechnology. The FCC cracker, in conjunction with a hydrotreater, shows potential in playing a major role in the commercial refining of coal derived liquids.

54048 (FE—2566-23) **Upgrading of coal liquids. Interim report: hydrocracking of H-coal process derived gas oils.** Tan, G.; DeRosset, A.J. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Nov 1978. Contract EF-77-C-01-2566. 145p. Dep. NTIS, PC A07/MF A01.

The objective of this work was to evaluate, by bench scale continuous tests, the applicability of commercial UOP hydrocracking processes to conversion of H-Coal atmospheric still bottoms. Commercial catalysts were used. Process conditions were within commercial ranges. Relative to conditions specified in a base case for hydrocracking Arabian gas oil, the pressures used ranged from 500 psig lower to 500 psig higher. Temperatures were generally within 20°C of base. Space velocities varied from one quarter of base up to base value. Catalysts, process conditions, and reactor sequences were varied to produce either gasoline, or environmentally acceptable No. 2 fuel oil. The H-Coal atmospheric bottoms were hydrotreated in one stage to give a low nitrogen, low sulfur fuel oil at 80% yield. Complete conversion to 600°F$^-$ distillate was achieved by processing the heavy ends in a second hydrocracking stage. Conversion of the H-Coal atmospheric bottoms to gasoline was carried out in two stages. The second stage comprised either a single hydrocracking reactor or two reactors in series flow. The latter arrangement yielded, under the process conditions employed, 98 volume percent of 93 octane C_6^+ gasoline, plus 28 volume percent of butanes. Hydrogen consumption was high, close to 4000 SCF/B for gasoline production and 1600 SCF/B for fuel oil production. This is a consequence of the aromaticity (85 volume percent) of the H-Coal atmospheric bottoms, as well as the high level of heterocyclic structures containing nitrogen, sulfur, and oxygen, which must be removed. In the gasoline case, about a half of this hydrogen can be recovered by steam reforming the light gases (C_1-C_3) produced, and reformingthe hydrocracked gasoline. Including butanes in the steam reformer feed should result in hydrogen balance.

54049 (PETC—0222-T1) **Exploratory research on mutagenic activity of coal related materials. Quarterly report of coal conversion sample - ETTM-10 and ETTM-11.** Warshawsky, D. (Cincinnati Univ., OH (USA). Coll. of Medicine). 16 Aug 1979. Contract EW-78-S-22-0222. 8p. Dep. NTIS, PC A02/MF A01.

Sample solutions were routinely filter sterilized and applied as 0.1 ml aliquots. Dilutions were made in dimethylsulfoxide (DMSO) so that these percentages of the original solution were tested: 100%, 50%, 10%, 5%, 1%. Organic solvent fractions were prepared as previously reported (EW-78-S-22-0222 final report) by sequential extraction with hexane, toluene, methylene chloride and acetonitrile. After the solvents had been evaporated under N_2, the remaining materials were prepared for assay as described above. In some cases there was insufficient material to perform five-point dose response assays. The following conclusions are summarized: Neither sample is mutagenic when rat liver extract is not applied. Both ETTM-10 and ETTM-11 are mutagenic for these Salmonella strains: TA1538, TA98 and TA100. The frameshift mutants TA1538 and TA98 are more sensitive to the action of the samples. ETTM-11 is the more mutagenic of the two. These 2 samples differ greatly in the organic solvent extractability. Both samples yielded a highly mutagenic component.

54050 (SAND—79-0738C) **Low temperature reaction path for coal liquefaction.** Thomas, M.G.; Traeger, R.K. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-790917—7). Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Onset of a solvent-coal reaction occurs in the 200 to 300°C temperature range. The temperature and extent of this reaction are dependent on the coal and solvent. In this initial reaction, THF soluble products increase but solvent is lost indicating formation of

THF soluble, coal-solvent reaction product. This reaction product, defined in the preasphaltene or asphaltal compounds, results in high viscosity products, possibly gels. These data show the coal itself does not undergo thermosolvolysis at temperatures to 300°C and free radical processes need not be invoked to explain the reactions observed in the 200 to 300°C range. The data do suggest an initial series reaction of coal + solvent → preasphaltenes. The hydrogen donating capability of the solvent does not appear to be critical, but functional groups that can interact with the coal and cause swelling are important. Preasphaltene chemistry needs further clarification. This reaction product imparts high viscosity to the slurry and its chemistry may influence subsequent liquefaction reactions. Understanding of this initial reaction is important to evaluate the applicability of advanced, two-stage liquefaction processes and could lead to the development of new, low temperature and pressure liquefaction schemes.

54051 (SAND—79-1216C) **X-ray imaging of coal derived products.** Thomas, M.G.; Sample, D.G. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790855—1). Dep. NTIS, PC A02/MF A01.

From Symposium on instrumentation and control for fossil energy processes; Denver, CO, USA (20 Aug 1979).

X-ray techniques have been developed for imaging flow and/or flow restrictions in coal liquefaction processing equipment. The two main areas addressed are (1) real time imaging of coal slurry flow characteristics, and (2) the residual buildup of coke and inorganic residues in piping, particularly tees and elbows, that carries the initial coal slurry and the products. The system used for (1) includes a 100 kV power supply, a Magnaflux 150 x-ray tube, photomultiplier detector, and a strip-chart recorder. Water and oxygen were used to simulate a two-phase coal-slurry/gas system. Analysis of the x-ray absorption has distinguished stratified, bubble, and slug flow; and the frequency and size of the gas displacements allow void volume determination. System (2) utilizes a Balteau portable x-ray unit and class II film. Phase boundaries between gas/coal-derived-liquids/coal are distinguishable and residue buildup has been detected in piping, tees, and elbows. These techniques are intended for use with existing equipment without the need for modifications.

54052 (SAND--79-1537) **Catalyst characterization in coal liquefaction. Second quarterly report, January 1-March 31, 1979.** Thomas, M.G. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

Analytical discrepancies in the analyses of Shell 324 NiMo catalyst used in the LC Finer process have been eliminated. Procedures for the analysis of these catalysts vary from standard procedures by 1) ashing at lower temperatures or using low temperature wet digestion, and 2) using the method of standard additions for determining analyte concentrations. Coke and metals, particularly iron and titanium, are major contaminants and 10 to 20% of the promoter metals are lost during the run. Tubing reactors have been constructed which allow liquefaction reactions to be studied with a two-minite heat-up and 30 second quench.

54053 **Method of improving yield in a coal liquefaction product deashing process.** Baldwin, R.A.; Davis, R.E.; Leonard, R.E.; Rhodes, D.E. (to Kerr-McGee Corp.). US Patent 4,164,466. 14 Aug 1979. Filed date 20 Mar 1978. 18p.

A coal deashing process is described wherein a feed mixture comprising soluble coal products, insoluble coal products and solvent is separated in a first separation zone into a first heavy phase and a first light phase comprising soluble coal products, solvent and some insoluble coal products. The first light phase is withdrawn and introduced into a second separation zone wherein it separates into a second heavy phase comprising insoluble coal products, soluble coal products and some solvent and a second light phase comprising soluble coal products and solvent. The second heavy phase is withdrawn and at least a portion is recycled to the first separation zone to increase the yield of separable soluble coal products ultimately recovered by the process. In alternate embodiments, additional solvents can be added to the first light phase before introduction into the second separation zone or the recycled portion of the second heavy phase may be introduced into a treatment zone before reintroduction into the first separation zone. The treatment zone effects an increase in the molecular weight of at least a portion of the recycled second heavy phase which facilitates subsequent separation in the first separation zone.

54054 **Method of feeding solids to a process unit.** Leonard, R.E. (to Kerr-McGee Corp.). US Patent 4,162,957. 31 Jul 1979. Filed date 20 Mar 1978. 6p.

The present invention related to a process wherein solidified coal liquefaction products with or without other solid materials can be simultaneously melted and introduced at an elevated pressure into a process unit. The melting and introduction of the coal liquefaction products with or without other solid materials into the process unit is accomplished by an extruder.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 54060

54055 (BNL—26210) **Flash hydropyrolysis of lignite and subbituminous coals to both liquid and gaseous hydrocarbon products.** Fallon, P.T.; Bhatt, B.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 18p. (CONF-790917—6). Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Flash Hydropyrolysis (FHP) is a short residence time (1 to 10 sec) gas phase noncatalytic coal hydrogenation process in which coal is converted directly to liquid and gaseous hydrocarbon products. Pulverized coal is contacted with hydrogen at elevated pressure and heated at average rates of 20,000 to 30,000°C/sec causing thermally-induced fractures in the polycyclic structure of the coal molecule. The free radicals formed readily add on hydrogen thus increasing the hydrogen to carbon ratio of 0.8 in the feed coal to approximately 1 to 4 depending upon whether liquid or gaseous hydrocarbons are formed. The products are then rapidly quenched to terminate the reaction and to prevent any decomposition or recombination. The purpose of this work is to provide data on the process chemistry of the reaction by studying the liquid and gaseous products formed as they vary with such operating parameters as temperature, pressure, and residence time. These results are also applied to a kinetic model and an economic evaluation of a large scale integrated coal conversion processing plant.

54056 **Production of hydrogenated hydrocarbons.** Duraiswamy, K. (to Occidental Petroleum Corp.). US Patent 4,162,959. 31 Jul 1979. Filed date 7 Dec 1977. 16p.

In a continuous process for recovery of values from a solid carbonaceous material, the carbonaceous material is pyrolyzed in the presence of a particulate source of heat to yield a particulate carbon-containing residue of pyrolysis and volatilized hydrocarbons while simultaneously the volatilized hydrocarbons are hydrogenated. The particulate source of heat is formed by oxidizing carbon in the solid residue to heat the particles. Hydrogen for hydrogenation is obtained by reacting at least a portion of the hot particulate carbon containing residue of pyrolysis with steam prior to feeding the hot particulate residue to the pyrolysis reaction zone. Steam and/or carbon dioxide can be introduced into the pyrolysis reaction zone to interact with carbon-containing residue contained therein. The particulate source of heat can be introduced to the pyrolysis reaction zone over an overflow weir.

54057 **Treatment of bituminous schists.** Legille, E.; Mahr, R. (to S.A. des Anciens Etablissements Paul Wurth). US Patent 4,152,243. 1 May 1979. Priority date 13 Aug 1976, Luxembourg, 6p.

A process for treating bituminous schists includes crushing the bituminous schist, feeding the schist to the top of a retort, pyrolyzing the crushed schist in the retort as it is moved downwardly therein through a combustion zone into which air is introduced, removing volatiles from the upper part of the retort, and removing spent schist from the bottom of the retort. The process being characterized by maintaining the combustion zone at a predetermined level in the retort by feeding the schist in a gradual and even manner.

BY-PRODUCTS

54058 **Method for cooling gases containing naphthalene, tar and solids.** Ullrich, H. US Patent 4,154,584. 15 May 1979. Priority date 16 Jul 1976, German, Federal Republic of (F.R. Germany), 4p.

Hot gases containing naphthalene and tar together with the possible inclusion of solids are contacted in a spray tower with water to cool the gases. A naphthalene extraction agent, such as tar, is vigorously admixed with water withdrawn from the spray tower. The admixture is separated in a settling tank from which water is obtained and recycled to the spray tower for cooling further quantities of gases. Solids, gas condensate and tar enriched with naphthalene are separately removed from the settling tank. 1 figure.

PROPERTIES

REFER ALSO TO CITATION(S) 54055, 54067, 55553

54059 (CONF-780903—, pp 95-101) **Comparative composition of petroleum and synthetic crude oils.** Dooley, J.E.; Sturm, G.P. Jr.; Scheppele, S.E.; Woodward, P.W.; Vogh, J.W. (Department of Energy, Bartlesville, OK). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

Five coal liquids prepared from four coals of varying rank were characterized by procedures previously developed for petroleum. The coal liquids were distilled into four fractions and separated by chromatography for subsequent spectral study. The data reported confirm the more aromatic, cyclic, and polar character of coal liquids and the higher nitrogen content compared with petroleum. To our knowledge, this study constitutes the most extensive systematic comparison of coal liquids with petroleum. 1 figure, 5 tables.

54060 (FE—2030-11) **Characteristics of American coals in relation to their conversion into clean energy fuels. Quarterly technical progress report, January-March 1978.** Spackman, W.; Davis, A.; Walker, P.L.; Lovell, H.L.; Essenhigh, R.H.; Vastola, F.J.; Given, P.H.; Suhr, N.H. (Pennsylvania State Univ., University Park (USA). Coal Research Section). 1978. Contract EX-76-C-01-2030. 85p. Dep. NTIS, PC A05/MF A01.

The Penn State/DOE Coal Sample Bank was expanded to include seventeen lignite seams from Texas and two samples of a western Kentucky coal. A total of 253 characterized coal samples and 539 selected printouts of coal data were provided to the coal research community. Results of further coal fractionation studies confirm previous conclusions that fractions of widely differing characteristics can be developed in the laboratory, and indicate that with appropriate process development they could be produced commercially. Knowledge of the detailed occurrence, associations, and format provides the basis for pyrite rejection during coal beneficiation. Operation of the isothermal furnace has continued using nitrogen as a pyrolysis medium at a temperature of 800°C. A study is being made into the effects of low temperature oxidation on reducing the agglomerating properties of caking coals. The ultimate aim is to thereby increase the reactivity of the chars produced. Thermogravimetric studies have shown that oxygen uptake can be followed both quantitatively and reproducibly. Removal of inorganic matter by acid treatment significantly changes the nitrogen and carbon dioxide areas of coals and chars. The effect is more pronounced in the case of chars. The effect of preoxidation in air of a highly caking coal in the temperature range 120-250°C on weight loss during pyrolysis up to 1000°C and reactivity of resultant chars to air at 470°C has been investigated. Preoxidation markedly enhances subsequent char reactivity. The mathematical model of a plane flame furnace firing char and low volatile fuel is being improved with the inclusion of radioative heat transfer from the flame to the walls, and of a conduction heat loss through the walls to the ambient. Experiments on the combustion characteristics of coal-oil mixtures have led to minor furnace and control modifications, improvements in operating procedures, and an improved basis for evaluating experimental data. (LTN)

54061 (IS-T—847) **Neutron-capture gamma-ray analysis of coal for sulfur, iron, silicon and moisture.** Fay, D.A. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 135p. Dep. NTIS, PC A07/MF A01.

Thesis.

Samples of coal weighing approximately 200 grams placed in a collimated beam of neutrons from the thermal column of the Ames Laboratory Research Reactor produced capture gamma-rays which could be used for the simultaneous determination of sulfur and iron. Spectra from NaI(Tl) and Ge(Li) detectors were used and interferences were located by examining spectra of the major elemental components of coal. In determining sulfur, iron is a potential source of interference when gamma-ray spectra are collected with a NaI(Tl) detector. Corrections for iron interference were made by use of a higher energy iron peak. The possibility of determining silicon in coal was investigated but this element determination was unsuccessful since capture gamma-ray spectrometry lacked the necessary sensitivity for silicon. A linear relation was found between the area of the hydrogen capture peak at 2.23 MeV and the amount of water added to coal.

54062 **Suspension of coal in fuel oils.** Bowers, W.E. (to Rolfite Co.). US Patent 4,163,644. 7 Aug 1979. Filed date 25 Apr 1978. 12p.

Suspensions of pulverized coal in fuel oil can be stabilized by treating fuel oil with an oil soluble polyamine containing at least two amino groups (or a polyamine which is rendered oil soluble upon reaction with suitable acid), then adding with agitation the desired amount of pulverized coal to the treated fuel oil and the finally stabilizing the mixture by adding an oil soluble polycarboxylic acid containing at least two carboxyl groups in an amount sufficient to stabilize the coal-fuel oil mixture. Suitable amines may be selected from the group consisting of N-alkyl 1,3 diamino propanes and higher N-alkyl amines having more than two amino groups. Suitable acids may be selected from the group consisting of polymerized fatty acids and alkenyl polycarboxylic acids.

54063 **Leaching rates of coal associated metals. Technical report No. 157.** Akers, D.J. Morgantown, WV; West Virginia University (1978). 7p. (NP—23987).

A number of metals are contained in coal. Some are present in mineral form and some are adsorbed on the coal itself. If a coal seam produces acid water, many of these metals are leached from the coal and discharged into surface or ground water systems. The objective of this research was to determine if there is a significant difference in the leaching rates of the metals under consideration and to attempt to approximate the source of any differences found. The metals studied were Al, Ca, Co, Cu, Fe, Mg, Mn, Ni, Pb, and Zn. Table 2 contains a listing of the average aqueous concentration of the ten elements under consideration as found in water draining from the Bud Waal's Mine immediately below the coal collection point. Also, the average coal concentrations of these metals are again presented. In order to compare coal leaching rates directly (by eliminating the coal concentration variable), each average elemental aqueous concentration was divided by the average elemental concentration in the coal to yield a leaching rate number (shown also in Table 2). This method indicates that the metals with the largest leaching rate numbers are being removed relatively quickly from the coal and those with the lowest, relatively slowly. When the metals are listed in order of leaching rate, the following series is produced: Mn > Ca > Mg > Zn > Pb > Fe > Ni > Cu > Co > Al. Based on the work of Ruch, Gluskoter and Shimp (1974), these metals can be divided into four groups: calcite metals, inorganic metals, organic metals, and clay metals.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54021, 54621, 54622

54064 (ANL/CEN/FE—79-11) **Effect of sodium carbonate additive on the reaction of SO_2/O_2 mixtures with carbonate rocks.** Shearer, J.A.; Lenc, J.F.; Johnson, I.; Turner, C.B. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 27p. Dep. NTIS, PC A03/MF A01.

A detailed investigation of the interaction of sodium carbonate with limestones during calcination and sulfation has been performed. Laboratory results show that the presence of the salt induces structural rearrangements in the stones. The interaction of salt and stone produces a weakly volatile liquid that increases the ionic diffusion and mobility of the system, enhancing decarbonation, enhancing recrystallization of CaO and $CaSO_4$, and providing a fluid medium favorable to reaction with SO_2/O_2 mixtures. Verification of the effect of Na_2CO_3 additive in a larger-scale process development unit is also reported. Sodium carbonate, when used as a mineralizing additive in fluidized-bed coal combustion, promotes the capture of sulfur dioxide by limestone. Sulfation of 50% of the CaO in the material to $CaSO_4$ can be achieved, which is a significant improvement over the average 30% sulfation of limestones under these conditions with additive absent. Sodium carbonate has a dramatic effect on the pore distribution of the calcined material, even at low concentrations. However, impurities in the natural stones reduce the effectiveness of the salt additive (1) by compound formation with the salt, and (2) by physical interference with recrystallization and pore growth. Liquid salt is present during sulfation, ensuring rapid sulfation of the CaO by promoting pore growth and increased gaseous diffusion, as well as providing a liquid medium for the reaction of dissolved gases and solids.

54065 (CONF-780903—, pp 23-31) **Solid waste management.** Boegly, W.J. Jr. (Oak Ridge National Lab., TN). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

Solid wastes produced in all stages of the coal fuel cycle (mining, processing, beneficiation, and utilization) may represent a major fraction of the total solid waste produced in the United States each year. Passage of the 1979 Resource Conservation and Recovery Act (RCRA) can produce significant impacts on generators of large volumes of solid waste. One of the key features of RCRA is the designation of wastes as being hazardous and nonhazardous depending on the results obtained by a standardized leaching test now under development. Hazardous solid wastes must be disposed of in landfills that ensure that no contamination results from leachates entering potential or existing water supplies. These landfills are likely to cost an order of magnitude more than nonhazardous landfills. To date, only limited experimental work has been performed to determine the physical and chemical properties and the leaching characteristics of these residues. This paper reviews most of the experimental studies performed to date. It also describes the ORNL Stored Solid Study, which is directed to the disposal of solids resulting from coal gasification. 5 figures, 5 tables.

54066 (FE—2549-T1) **Development of potential uses for the residue from fluidized bed combustion processes. Quarterly technical progress report, December 1978-February 1979.** Minnick, L.J. (Min-

nick (L.J.), Inc., Plymouth Meeting, PA (USA)). 1979. Contract EF-77-C-01-2549. 36p. Dep. NTIS PC A03/MF A01.

In most cases, there appears to be an optimum development of compressive strength in stabilized road base compositions when AFB residue and fly ash are proportioned on an equal weight basis in the mix. However, exceptionally high strengths are also evident with higher percentage additions of AFB residue. At this time, there is no clear indication of an optimum ratio of aggregate to total additive (AFB residue and fly ash). Initial behavior of such stabilized road base material at the experimental section in eastern Ohio indicates that further investigation of the expansive properties of these formulations is necessary. Variations in operating parameters and bed compositions can have a great influence on the character of spent bed residues, as evidenced by the substantial differences noted in residue samples from the pilot AFB plant in Alexandria, Virginia. Initial studies confirm that low percentage additions of AFB residue to municipal sewage sludge result in significant improvements in the settling and dewatering characteristics. Pelletized aggregate products made from AFB residue and fly ash are potentially useful in lightweight concrete applications, particularly those aggregates made from a roll pelletizer, in which the AFB residue comprises up to 80 percent by weight of the pelletized aggregate. Replacement of all or part of the fine aggregate portion in concrete masonry block mixtures by AFB residue has resulted in an apparent improvement in the masonry block product. Extended curing of AFB masonry block for periods up to one year produces increased compressive strength and slightly increased density of the block with no adverse volume changes. The use of AFB residue as a partial replacement for portland cement in portland cement concrete mixes is not particularly promising.

54067 (FE—2721-6) **Utilization of coal associated minerals. Quarterly report No. 6, January 1-March 31, 1979.** Slonaker, J.F.; Alderman, J.K.; Gierl, D.B.; Grady, W.C.; McMillan, B.G.; Muter, R.B.; Simonyi, T.A. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 29 Jun 1979. Contract EF-77-S-01-2721. 30p. Dep. NTIS, PC A03/MF A01.

Laboratory analysis of physical and chemical properties has continued on representative samples of plant feed coal as well as washed coal and refuse from the Pittsburgh seam. Further characterization of the Pittsburgh sample included correlations between maceral groups, macerals, and mineral matter in head and float-sink fractions. Qualitative mineral distribution trends were also identified for head samples from the Pittsburgh seam using ir, and a special die and pressing technique was developed for use with the Phillips APD-3501 x-ray diffractometer. Additional work was performed to determine the utilization of Pope, Evans and Robbins fluidized-bed combustion by-products in fired structural materials. The utilization potential of this spent limestone bed ash as an aggregate in fired structural products has been shown to be unfeasible because of cracks and fissures in the structural products. The cracks and fissures are caused by free lime in the bed ash hydrating and expanding after being wetted during the mixing cycle.

54068 (FE—2721-T2) **Lightweight flyash brick. Technical report No. 153.** Slonaker, J.F. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). Jun 1978. Contract EF-77-S-01-2721. 16p. Dep. NTIS, PC A02/MF A01.

The Coal Research Bureau of West Virginia University, under contract to the Department of Energy, has developed a process for producing fired structural products from flyash and bottom slag, both of which are recyclable minerals produced in electric utility boilers. All of these fired structural products meet or exceed American Society for Testing and Materials specifications for facing brick. A study has been completed to reduce the weight of the fired structural products by replacing the bottom slag with lightweight flyash aggregate. The use of lightweight flyash aggregate in flyash brick results in a brick having a significantly reduced bulk density. The resulting lightweight flyash brick possesses many desirable qualitites, perhaps the most important of which is the improved thermal insulating characterisitics.

54069 (LA-UR—79-1919) **Control technology strategies for coal preparation waste drainages.** Wagner, P.; Williams, J.M.; Bertino, J.P.; Wangen, L.E.; Wanek, P.L.; Jones, M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 34p. (CONF-7906104—1). Dep. NTIS, PC A03/MF A01.

From Wastewater workshop; Germantown, MD, USA (14 Jun 1979).

The purpose of this project is to investigate in the laboratory the options available for treating high-sulfur coal refuse materials either at the preparation plant or during disposal to prevent or reduce subsequent releases of environmentally harmful trace elements during waste dump weathering and leaching. Such control technology might include (1) chemical or physical processing to remove the undesirable elements from the refuse or treating the refuse materials to immobilize these elements; (2) applying neutralizing agents, adsorbents, or sealants at the refuse dump site, and burying, grading, and compacting the waste materials to control the flow of water and air through refuse piles; or (3) treating the contaminated drainage itself to reduce the contaminant concentration to environmentally acceptable levels. These three basic environmental control categories are discussed in this presentation.

54070 (LA-UR—79-2041) **Assessment of trace element contamination of the drainages from coal cleaning wastes.** Wagner, P.; Williams, J.M.; Wewerka, E.M.; Bertino, J.P.; Wangen, L.W.; Wanek, P.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 19p. (CONF-791108—1). Dep. NTIS, PC A02/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The mineral wastes produced by coal cleaning contain an abundance of toxic or potentially harmful trace elements. Although it has been well established that many of these toxic elements are present in the drainages from coal waste dumps, little is known about the quantities released into the environment from this source. The objectives of an ongoing research program at the Los Alamos Scientific Laboratory are to assess the nature and magnitude of the trace elements in the effluents from coal refuse materials, and to develop appropriate environmental control technologies as needed. Recent experimental results concerning the chemistry and aqueous leaching behavior of the trace elements in high sulfur coal cleaning wastes are presented. The emphasis is on the interpretation of the experimental data that has led to the identification of the trace elements in coal refuse effluents that are consistently present in unacceptable quantities, and the development of environmental control strategies designed to abate or mitigate the problems of environmental control strategies designed to abate or mitigate the problems of environmental concern that have resulted from these refuse drainages.

54071 **Disposal of hazardous wastes.** Barnhart, B.J. (Los Alamos Scientific Lab., NM). *Environ. Sci. Technol.;* **12**: 1132-1136(Oct 1978).

The Fifth Life Sciences Symposium entitled Hazardous Solid Wastes and Their Disposal on October 12 through 14, 1977 was summarized. The topic was the passage of the National Resources Conservation and Recovery Act of 1976 will force some type of action on all hazardous solid wastes. Some major points covered were: the formulation of a definition of a hazardous solid waste, assessment of long-term risk, list of specific materials or general criteria to specify the wastes of concern, Bioethics, sources of hazardous waste, industrial and agricultural wastes, coal wastes, radioactive wastes, and disposal of wastes.

54072 (FE—1218-T3) **Characterization of coal refuse. Technical report No. 159.** Buttermore, W.H.; Simcoe, E.J.; Maloy, M.A. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). [nd]. Contract EX-76-C-01-1218. 141p. Dep. NTIS, PC A07/MF A01.

The purpose of this study was to determine the composition of bituminous coal wastes and determine whether significant variance can be expected according to geographical source area. This information can then be applied to disposal, beneficiation, or utilization schemes to assist in determining whether processes or end uses should be approached on a local, regional, or national level. The data compiled for wastes in the major producing districts appearing later in this report can be used for the more accurate planning and implementation of such programs. Based upon the analyses presented, no consistent, significant variance in composition was noted according to geographical source area. This conclusion, if not predictable, is supported by the fact that all wastes sampled were associated with a very distinct rock type, i.e., bituminous coal; and the minerals associated with a specific rock type are likely to be similar. In most cases, samples within the same mining district varied more than those from different districts. The conclusion can be drawn that differences in composition and physical properties of coal wastes are more greatly influenced by mining and preparation methods than geographical source area.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54028, 54070, 55505, 55506

54073 (CONF-780903—) **Proceedings of the symposium on potential health and environmental effects of synthetic fossil fuel technologies.** (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract W-7405-ENG-26. 293p. Dep. NTIS, PC A13/MF A01.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

This symposium included five sessions. Session I dealt with the technology for contending with harmful effluents primarily from coal conversion processes. Session II was designed to address the need for the systematic application of existing capabilities to the collection and characterization of materials of importance to the life scientists. Session III had the underlying theme of the health effects

research - biologists, chemists, and technologists working together to confront the problems of the emerging industries. Session IV provided the most recent data in the areas of atmospheric, solid, and liquid releases. Session V dealt with effects on humans and on those people who may potentially be affected by the toxic material that they produce. In summary, the sessions were: technology, chemical, characterization, biological effects, environmental and ecological effects and occupational health effects. 29 pages were included.

54074 Environmental characterization of HYGAS pilot plant water streams. Anastasia, L.J.; Jonardi, R.J.; Karst, R.H.; Bossart, S.J. Chicago, IL; Institute of Gas Technology (1979). 20p. (CONF-790822—10).

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

This report discusses data acquisition and interpretation for process water characterization in the HYGAS pilot plant. Emphasis is placed on the pretreatment and gasification sections, which are considered scalable to larger plants. Aqueous components with potential environmental impacts have been identified, quantified, and, where possible, related to processing parameters and coal type. Biological treatability characteristics are summarized for cyclone and quench waters obtained while processing bituminous coal.

MINING

54075 (DOE/EIA—0119(76)) **Coal: Pennsylvania anthracite in 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 30p. NTIS, PC A03/MF A01.

All of the reported production of anthracite in 1976 was produced in northeastern Pennsylvania. The total production in 1976 was 6.2 million short tons, a slight increase of 0.4% over the amount produced in 1975. Of the total output, 48% was produced at strip pits, 41% was recovered from culm banks, 9% was produced at underground mines, and approximately 2% was recovered from river dredging operations. In comparing 1976 with 1975, there were increases of 17.0% in production from strip mines and 15.5% in the recovery of river coal. There were decreases of 12.5% in culm recovery and 8.9% in production from underground mines. The total value of the 1976 output was $209.2 million, a 5.4% increase over the 1975 value. The average commercial value, f.o.b. preparation plants for all sizes, increased $1.67 per ton (from $45.04 to $46.71), and the average value of buckwheat No. 1 and smaller sizes increased $1.50 per ton (from $27.61 to $29.11).

54076 (DOE/EIA—0125(77-78)) **Bituminous coal and lignite distribution, January-September 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 239p. NTIS, PC A11/MF A01.

Shipments of bituminous coal and lignite are given quarterly for 1977-1978 from coal producing districts of origin to states of destination, by types of consumer use and by methods of transportation. Railroads are the principal mode of transportation. (LTN)

54077 (DOE/EIA—0126(76)) **Distribution of Pennsylvania anthracite for the calendar year, 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 8p. NTIS, PC A02/MF A01.

For the calendar year 1976, shipments of Pennsylvania anthracite totaled 6,122,743 net tons, an increase of 3.0% over those for 1975. Shipments to markets within the United States comprised 80.6% of all shipments, 7.3% was exported to Canada, and the remainder was shipped to other foreign countries. Exports in 1976, when compared with those in 1975, indicate a 3.8% decline. The report presents detailed and summarized data on distribution of Pennsylvania anthracite by size and carrier method. The data cover shipments to selected major cities, States, Canadian provinces, and other countries.

54078 (DOE/EIA—0127(77-78)) **Pennsylvania anthracite weekly production, 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 46p. NTIS, PC A05/MF A01.

The weekly production of anthracite in Pennsylvania is given for 1976-1978. (LTN)

54079 (DOE/EIA—0128(77-78)) **Production of coal bituminous and lignite, 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 88p. NTIS, PC A09/MF A01.

Weekly production of bituminous coal and lignite is given for 1977-1978; includes production by individual states. (LTN)

54080 Coal-rock interface detector. Frosch, R.A.; Rose, S.D.; Crouch, C.E.; Jones, E.W. US Patent 4,165,460. 21 Aug 1979. Filed date 4 Nov 1977. 6p.

In accordance with the invention, a gamma backscatter coal interface detector is mounted on an arm supporting a coal cutting head, and, by means of parallelogram coupled arms, supports a platform member for movement vertically without angular change of the platform member. A radiation source and radiation sensor of the detector are separately positioned on the platform member, and each is independently raised or lowered from the platform member by means of an air cushioned hydraulic system, whereby as cutting progresses and irregularities in the top surface occur, the radiation source and sensor individually follow the smaller area portions of the surface, and thereby substantially reduce cavities between each of these and the surface. As a result, the accuracy of the detector is greatly increased.

54081 Directional drilling apparatus. Edmond, T.O.; Schroeder, R.L.; Smith, C.C. (to Continental Oil Company). US Patent 4,153,119. 8 May 1979. Filed date 10 Apr 1978. 4p.

A device for facilitating directional drilling of small diameter holes radially of a mine long hole comprises a segmented sleeve for movement through a guide channel in a main drill unit. A small bit is driven by a flexible shaft which passes through the segmented sleeve. The segmented sleeve remains partially in the guide channel and extends partially out of the guide channel in a straight line from the guide channel. The segments are joined in a manner permitting a 90° turn in the guide channel but allowing no curvature in the portion of the segmented sleeve extending from the guide channel.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 54020, 54043, 54058

54082 Turbine system using unclean fuel. Taylor, D.W.; Fulton, L. (to Combustion Turbine Power, Inc.). US Patent 4,164,124. 14 Aug 1979. Filed date 22 Nov 1976. 16p.

Unclean fuel, such as coal is reduced to particle size passing 200 mesh in an attrition mill. Pyrite and ash removal is performed in conjunction with the attrition milling. The resulting fine particles are combusted in the turbine exhaust gas and the products of combustion indirectly heat the turbine operating gas. Control is provided by bypass around the heat exchanger and/or auxiliary clean fuel combustion.

54083 Coal washing plant employing a feed equalizer and a critically dimensioned deflector surface in the inlet pipes of a plurality of cyclones. Liller, D.I. US Patent 4,164,467. 14 Aug 1979. Filed date 19 Jul 1978. 28p.

A single stage or multi-stage coal washing plant comprises a plurality of bunched cyclones supplied with raw crushed coal water slurry at high solids content and high velocity common from a tank through a distributor line that contains an equalizer for supplying equal quantities of solids to each cyclone through an inlet pipe having a critically dimensioned deflector that assists in maintaining streamlined laminar flow. A dewatering screen is used in combination with a centrifual drier; the water separated from the refuse and clean coal is recycled to a silt pond. A make up water reservoir receives the overflowing water from the silt pond and a caustic soda tank supplies sodium hydroxide between the pump and the reservoir to neutralize acidity during continuous operation.

54084 Fluidizing a mixture of particulate coal and char. Green, N.W. (to Occidental Petroleum Corp.). US Patent 4,163,693. 7 Aug 1979. Filed date 20 Nov 1975. 10p.

Method of mixing particulate materials comprises contacting a primary source and a secondary source thereof whereby resulting mixture ensues; preferably at least one of the two sources has enough motion to insure good mixing and the particulate materials may be heat treated if desired. Apparatus for such mixing comprising an inlet for a primary source, a reactor communicating therewith, a feeding means for supplying a secondary source to the reactor, and an inlet for the secondary source. Feeding means is preferably adapted to supply fluidized materials.

54085 Process for the discharge of ash concentrate from a coal deashing system. Baldwin, R.A. (to Kerr-McGee Corp.). US Patent 4,162,958. 31 Jul 1979. Filed date 20 Mar 1978. 6p.

An improved process for the continuous discharge from a first separation zone of a first heavy fraction comprising insoluble coal products and solvent in a coal deashing process utilizing solvents at elevated pressures and temperatures near the critical temperature of the solvent. The continuous discharge of the insoluble coal products in a dry, powdery form, is achieved by monitoring the temperature level of the solvent and insoluble coal products within a transfer conduit after withdrawal and pressure reduction from the first separation zone operating pressure, at a temperature below about 550 degress F.

54086 Method of handling ash-rich material in a coal deashing process. Leonard, R.E. (to Kerr-McGee Corp.). US Patent 4,162,964. 31 Jul 1979. Filed date 20 Mar 1978. 6p.

A process and apparatus are described for maintaining continuous operation of a coal deashing process during period of normal operation wherein a dry, powdery ash concentrate composition is produced and during process upsets wherein undesired semi-solids or fluid compositions are produced.

54087 Flotation of deep mined coal with water-in-oil emulsions of sodium polyacrylate. Finch, R.E. (to Nalco Chemical Company). US Patent 4,162,966. 31 Jul 1979. Filed date 19 Jan 1978. 8p.

A method and treating agent are described for increasing the yield of deep mined coal mined from a site 100 feet or more below the surface where the particles in the coal are concentrated by froth flotation. This method consists of utilizing as a promoter or frothing aid about 0.05 to 1.5 lbs of sodium polyacrylate latex per ton of dry coal (0.017 to 0.5 lb of dry sodium polyacrylate per ton of dry coal), having an average molecular weight of about 100,000 to 1,000,000 and more, with a preferred range of 1,000,000 or more. The preferred promoter or frothing aid for deep mined coal is a water-in-oil latex of sodium polyacrylate preferably used with an alcohol-type frother. The latex may be utilized neat and self inverts with the assistance of an oil-in-water surfactant (or activator) and the water in the system upon application to form an oil-in-water emulsion, or it may be used as a two-part system with an activator (aqueous) to promote inversion. The latex emulsion has demonstrated superiority as a flotation promoter for deep mined coal over the dry polymer and exhibits synergism over the dry polymer and over the components of the latex emulsion including a paraffin solvent, a hydrophobic emulsifier such as sorbitan monooleate, a solvent such as Espesol 3-E (Charter; an aromatic blend) and stabilizers such as polyisobutylene and aluminum tristerate.

54088 Ore grinding process. Katzer, M.F.; Klimpel, R.R.; Manfroy, W. (to Dow Chemical Co.). US Patent 4,162,045. 24 Jul 1979. Filed date 11 Aug 1978. 10p.

A process for grinding coal or ores containing metal values comprising carrying out said grinding in a liquid medium and with a grinding aid system comprising an anionic polyelectrolyte derived from polyacrylic acid and certain inorganic metal salts, said system being dispersible in the liquid medium and being present in an amount effective to provide increased grinding efficiency.

54089 Process for grinding coal or ores in a liquid medium. Manfroy, W.; Klimpel, R.R. (to Dow Chemical Co.). US Patent 4,162,044. 24 Jul 1979. Filed date 11 Aug 1978. 14p.

A process is described for grinding coal or ores containing metal values comprising carrying out the grinding in a liquid medium and with a grinding aid comprising an anionic polyelectrolyte derived from polyacrylic acid and dispersible in the liquid medium. The grinding aid is present in an amount effective to provide increased grinding efficiency.

54090 DOE research in high gradient magnetic separation applied to coal beneficiation. Hucko, R.E. (Dept. of Energy, Pittsburgh, PA). pp 77-82 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The Coal Preparation and Analysis Laboratory of the Department of Energy has funded three contracts, and continues to conduct in-house research involving the application of high gradient magnetic separation (HGMS) to coal beneficiation. Each of these research programs is described; (i) Separation of pyrite from dry coal fines (contract carried out by General Electric in conjunction with MIT and Eastern Associated Coal Corporation); (ii) Separation of pyrite from coal utilizing oil as a carrier medium (contract carried out by the Naval Ordnance Station, Indian Head, Maryland); (iii) Recovery of magnetite from dense-medium circuits (contract carried out by MIT); and (iv) Investigation of the effect of dispersants, and comparison of the effectiveness of HGMS with the two-stage Coal Pyrite Flotation Process (in-house research ongoing at the Bruceton Research Center). In summary, it can be stated that the results achieved by flotation and HGMS, and coal-pyrite flotation are very similar with respect to pyritic sulfur reduction for the minus 35-mesh size fraction of the coal examined in this study. Regarding ash reduction, flotation followed by HGMS is slightly better. HGMS also appears to yield better results when treating finer-size feeds. It must be stressed that the rsults attributed to HGMS were enhanced by the prior flotation treatment; HGMS cannot compete with conventional froth flotation as far as ash reduction is concerned. Consequently, it is highly unlikely that HGMS would ever be utilized (for coal preparation) independent of flotation or some other beneficiation process. In addition, perhaps the most important point to remember is that economic factors have not been considered throughout this assessment.

54091 Process design considerations for the cleaning of wet pulverized coal by high gradient magnetic separation. Slaughter, W.W. (Electric Power Research Inst., Palo Alto, CA); Karlson, F.V. pp 83-90 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

A commercial process design for the cleaning of wet pulverized coal utilizing high gradient magnetic separation is presented. Emphasis is placed on those unit operations which are necessary in conjunction with the magnetic separation equipment to prepare coal for use by an electric utility. Potential processing problems are identified, and research and development implications for high gradient magnetic separation equipment developers are discussed.

54092 High gradient magnetic desulfurization of solvent refined coal. Petrakis, L.; Ahner, P.F.; Kiviat, F.E. (Gulf Science and Technology Center, Pittsburgh, PA). pp 95-98 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

A process solvent-diluted filter feed from a solvent refined coal (SRC) process has been subjected to high gradient magnetic separation (HGMS). The effects of the magnetic separator parameters (matrix type, matrix packing density), filter feed residence time, magnetic field strength, and temperature upon the desulfurization and deashing of the diluted SRC filter feed are discussed. Consideration is also given to the magnetic separation of solids from the filter feed. The experimental results presented herein have demonstrated that HGMS is routinely capable of removing 96 to 98% of the ash, all of the inorganic sulfur, and 95% of all the solids at a feed velocity of approximately 0.2 cm/sec, a field strength of 2 Tesla, and a temperature of approximately 190°C. Furthermore, it has been demonstrated that performance does not degrade with successive backwashing, and a cyclic HGMS operation is feasible.

54093 Magnex process: review and current status. Kindig, J.K. (Hazen Research, Inc., Golden, CO). pp 99-104 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The Magnex process is a dry process for cleaning coal which involves four basic steps: crushing, heating, carbonyl treatment and magnetic separation. In the process, coal is first crushed to liberate or expose pyrite and ash. The crushed coal is heated to 170 C (338 F) prior to carbonyl treatment. The hot coal is contacted with vapors of iron carbonyl, which decomposes and enhances the magnetic susceptibility of pyrite and ash. The pyrite and ash are removed from the carbonyl-treated coal by dry magnetic separators operating at 8 to 12 kilogauss. The pyrite and ash are concentrated in the magnetic refuse. The dry nonmagnetic coal fraction which may represent 85% of the feed coal weight, is ready for steam or metallurgical application. In this article, the basic processing steps of the process are reviewed, and the current status of the pilot-scale process development are summarized.

54094 Coal beneficiation with magnetic fluids. Sladek, T.A.; Cox, C.H. (Colorado School of Mines Research Inst., Golden). pp 105-111 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Magnetic fluids and their potential applications to coal cleaning are discussed. A laboratory program is described in which magnetic fluids are used in combination with several commercial magnetic separators to achieve substantial levels of coal beneficiation. Preliminary results are given, problems are identified, and a plan is presented for the balance of the program. The primary goal of the Colorado School of Mines Research Institute (CSMRI) research program is to determine if such magnetic coal processing could be improved through use of magnetic fluids. The technique which is being evaluated involves selective wetting of specific coal constituents with a magnetic fluid of high susceptibility. It should then be possible to remove the wetted constituents in conventional magnetic separators.

COMBUSTION

REFER ALSO TO CITATION(S) 54025, 54060, 54062, 54064, 54082, 54102, 54103, 54104, 54608, 54609, 54617

54095 (CONF-790640—2) **Wall combustion in high-swirl combustors.** Chung, P.M.; Smith, R.S. (Argonne National Lab., IL

(USA)). 1979. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 18. symposium on engineering aspects of magnetohydrodynamics; Butte, MT, USA (18 Jun 1979).

The burning rate of char along the wall of an idealized swirl combustor is analyzed. Combustion by O_2, H_2O, and CO_2 is considered. The combustion rate largely depends on the swirl and roughness of the char layer-gasphase interface, which set the turbelence level, and on the gaseous reactant Damkohler number. In general, the higher the pressure and the smaller the char particle size, the more efficient the gas core combustion is, when compared to wall combustion. On the other hand the reverse is true at lower pressures and for the larger particles.

54096 (CONF-7810153—) **Proceedings of a workshop on fine particulate emissions from fluidized bed and conventional combustion.** (Department of Energy, Washington, DC (USA)). Aug 1979. 123p. Dep. NTIS, PC A06/MF A01.

From Conference on fire particulate emmissions form fluid bed and conventional combustions; Washington, DC, USA (23 Oct 1978).

As part of the continuing Program Review process in EV-OHER a small workshop was held on October 23-24, 1978, to review the status of knowledge about potential Health Effects of Fine Particulate Emissions of Advanced versus Conventional Coal Combustion Processes. The major emphasis was placed on progress made in DOE-sponsored research addressing the subject. Similar and complementary efforts of other Federally supported work was discussed. Papers have been entered individually into EDB and ERA. (LTN)

54097 (FE—2018-12) **Fundamentals of nitric oxide formation in fossil fuel combustion. Progress report, 29 September 1978-28 March 1979.** Houser, T. (Western Michigan Univ., Kalamazoo (USA). Dept. of Chemistry). Jul 1979. Contract EX-76-C-01-2018. 8p. Dep. NTIS, PC A02/MF A01.

A series of preliminary experiments were conducted to determine the conditions underwhich NO would be formed during the oxidation of pyridine, acetonitrile and vinyl cyanide. These led to the conclusion that no NO was formed under fuel rich conditions, although some oxygen was not consumed. In addition, it was concluded that the oxidizing properties of HCN could not be predicted from those of organic nitriles, thus, requiring the study of HCN oxidation directly.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54075

54098 (CONF-790747—2) **Analysis of coal development issues with the Argonne Coal Market Model.** Macal, C.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

From Coal modeling conference; Bozeman, MT, USA (25 Jul 1979).

This paper describes the Argonne Coal Market (ACM) Model and its use in analyzing coal related issues. The quadratic programming framework for combining supply and demand data in an interregional model is briefly described in the first section. Supply and demand data and algorithms used in estimating coal transport and environmental control cost data are presented in the second section. The last section contains a description of previous uses of the model.

54099 (DOE/EIA—0120(76)) **Coke and coal chemicals in 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 39p. NTIS, PC A03/MF A01.

Production of coal coke in the United States totaled 58.3 million tons in 1976 and was 2% more than in 1975, principally to satisfy an 8.8% increase in production of pig iron and ferroalloys in blast furnaces. Also contributing to the increase were a 15.1% increase in shipments of foundry coke and a 36.9% increase of coke shipped for other industrial plants.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 54049, 54073, 54096, 55624

54100 (CONF-780903—, pp 163-175) **Inhalation toxicology of primary effluents from fossil fuel conversion and use.** Hobbs, C.H.; Clark, C.R.; Griffis, L.C.; McClellan, R.O.; Henderson, R.F.; Hill, J.O.; Royer, R.E. (Lovelace Biomedical and Environmental Research Inst., Inc., Albuquerque, NM). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

Studies have been started to better define inhalation hazards to man from potential effluents from fluidized bed combustion (FBC) or low-Btu gasification of coal. Samples of potential airborne effluents have been collected from an experimental FBC and an experimental gasifier located at the Morgantown Energy Technology Center. Aerosols from these units have been characterized as to their chemical and physical properties. A series of in vivo and in vitro toxicological tests on the potential effluents have been started. Some extracts of particles collected from the FBC were mutagenic in the Salmonella/mammalian microsome mutagenicity (Ames) test, as were fractions of extracts of samples of the gasifier. However, the mutagenicity of FBC fly-ash extracts appears to be no greater and perhaps less than that reported for fly ash from a conventional coal combustor. Further in vitro and in vivo testing is needed to establish the significance of these results. Studies on the deposition and retention of FBC fly ash following inhalation by experimental animals have been started as have tests for acute pulmonary injury. These studies will be followed soon by chronic inhalation studies in experimental animals. 3 figures, 12 tables.

54101 (CONF-790855—2) **Portable fluorometric monitor to detect polynuclear aromatic hydrocarbon contamination of work area surfaces.** Schuresko, D.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From Symposium on instrumentation and control for fossil energy processes; Denver, CO, USA (20 Aug 1979).

A hand-held fluorometric monitor for detection of surface contamination by polynuclear aromatic (PNA) compounds is described. The instrument will indicate the presence of microgram quantities of PNA in the workplace at distances $\leqq$ 1 m. Laboratory test data using coal liquefaction products and wastes are presented. It is anticipated that this type of spotter will be used extensively in monitoring for PNA contamination of the clean areas of coal conversion facilities, such as lunch rooms, shops, changing facilities, the control room, etc. Actual field evaluation of two spotter units at several coal conversion pilot plants is scheduled to begin during FY 1980.

54102 (CONF-7810153—, pp 12-41) **Activities at Argonne National Laboratory in evaluating the potential toxicity of effluents from fluidized bed combustion of coal. Appendix 1.** Aug 1979.

From Conference on fire particulate emmissions form fluid bed and conventional combustions; Washington, DC, USA (23 Oct 1978).

It is concluded that: the effluent stream from the ANL PFBC contains appreciable quantities of mutagenic/cytotoxic organic materials. Much of this organic material is sufficiently volatile that it passes through the final filter which operates at a temperature of 150 to 170°C. If this effluent stream were vented to the atmosphere at a temperature of ~ 150°C (as typically occurs in coal burning power stations), the organic component could be expected to adsorb to the surfaces of the accompanying particulate material. This could, potentially, have a significant effect on the toxicity/carcinogenicity of the effluent. A portion of these mutagenic/cytotoxic materials are solubilized by proteins (e.g., serum). This observation is significant in assessments of potential toxicity of inhaled/ingested materials. The mutagenicity of the organic component of the effluent resides largely in the more polar fractions. The ANL bench-scale PFBC is probably not directly scalable to larger units. These data were collected from samples obtained with the PFBC operating under well-defined conditions. There is not yet sufficient information, however, to determine the effect that changing process conditions may have on the compostion/mutagenicity/cytotoxicity of the effluent stream.

54103 (CONF-7810153—, pp 42-82) **Current status of the Inhalation Toxicology Research Institute's Fluidized Bed Combustion Toxicology Program. Appendix 2.** Aug 1979.

From Conference on fire particulate emmissions form fluid bed and conventional combustions; Washington, DC, USA (23 Oct 1978).

The Inhalation Toxicology Research Institute has been actively engaged in a research effort with the Morgantown Energy Technology Center to determine the potential risk to man from fluidized bed combustion of coal. Special emphasis has been given to comparisons between the FBC available information and that from the conventional combustion of coal. The major findings and conclusions are summarized: Fluidized bed combustor emissions are comparable or lower than from conventional power plants. Fluidized bed combustor particle emissions approach proposed NSPS requirements. Calcium and sulfur are seldom found as individual particles in fluidized bed combustor fly ash. Fluidized bed combustor particulate polycyclic organic emissions are higher than estimated for conventional power plants. Fluidized bed combustor hydrocarbon emissions are primarily vapor phase as measured. Fluidized bed trace element emissions are comparable or lower than conventional power plant

emissions. Mutagenic activity has been detected in some baghouse fly ash samples from the fluidized bed combustor, but not in size fractioned ash sample from the FBC stack. Tests for carcinogenicity have not been conducted. The mutagenic activity varies with different samples from the same fluidized bed combustor. Some cytotoxicity of fluidized bed combustor fly ash has been observed. Single inhalation exposure to low concentrations of baghouse fly ash resulted in biochemical changes, indicative of mild inflammatory response. Chronic inhalation exposures of laboratory animals to aerosols of both fluidized bed combustor and conventional power plant fly ash are necessary to evaluate their comparative toxicities and their potential hazard to man. (LTN)

54104 (CONF-7810153—, pp 83-118) **Evaluation of the potential health impact of fine particle emissions from coal combustion: status of University of California research. Appendix 3.** Fisher, G.L. (Univ. of California, Davis); Raabe, O.G.; Goldman, M.; Ondov, J.M.; Bierman, A.H.; Pitts, J.N. Jr.; Van Cauwenberghe, K.; Belser, W.L. Jr. Aug 1979.

From Conference on fire particulate emmissions form fluid bed and conventional combustions; Washington, DC, USA (23 Oct 1978).

The nation's expanding reliance on coal has made increasingly more important the design, development, and implementation of efficient advanced coal technologies such as fluidized bed combustion that may ameliorate potential health and environmental hazards. To achieve these goals, detailed studies of the physical, chemical, and biological properties of fine particle emissions from conventional power plants will be used to provide the data base to allow subsequent comparison with particulate emissions from advanced coal combustion technologies. Evaluation of emissions from conventional power plants should consist of comparative studies of fine particles released from the various particle abatement technologies. These studies must include basic research efforts to evaluate mechanisms of fine particle formation, atmospheric transformation and biological interaction. To address these research needs, intensive and integrative studies are underway at three University of California laboratories: Radiobiology Laboratory, Davis; Lawrence Livermore Laboratory, Livermore; and California Statewide Air Pollution Research center, Riverside.

PETROLEUM

REFER ALSO TO CITATION(S) 55107, 55126

GEOLOGY AND EXPLORATION

54105 (NP—23878) **Petroleum and natural gas in our country.** (Wirtschaftsverband Erdoel- und Erdgasgewinnung e.V., Hannover (Germany, F.R.)). [nd]. 17p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The brochure reports on German petroleum and natural gas deposits, methods for petroleum and natural gas exploration and extraction, and drilling and hauling techniques.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 54010, 54168

54106 (BETC—1809-12) **Interfacial effects in the recovery of residual oil by displacement: studies at Northwestern University. Annual report, March 1978-February 1979.** Slattery, J.C.; Kovitz, A.A. (Northwestern Univ., Evanston, IL (USA)). Aug 1979. Contract ET-76-S-03-1809. 33p. Dep. NTIS, PC A03/MF A01.

A generalized Washburn equation has been derived for the limiting case in which motions within the interface are dominated by the interfacial forces rather than by the bulk viscous forces. It predicts that the interfacial viscosities play a major role in displacement, the interfacial tension having been assumed to be below the critical value for movement. Significant progress has been made in developing three different interfacial viscometers, two of which are appropriate for use with liquid-liquid interfaces.

54107 (BETC/W—26-4) **Chemicals for enhanced oil recovery. Annual report, April 1977-April 1978.** Baldwin, W.H.; Compere, A.L.; Crenshaw, J.M. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 57p. Dep. NTIS, PC A04/MF A01.

Surfactant evaluations were concentrated on the tall-oil by-products of pulping of softwoods by the kraft process. With sodium oleate, no conditions were identified under which aqueous-hydrocarbon interfacial tensions were not at least a factor of fifty higher than the best millidyne value for efficient oil recovery. Results with simulated and real tall-oil mixtures were even less promising. A derivaNve with an ethyl group on the carbon adjacent to the carboxylate was prepared, and its interfacial properties were radically different from those with sodium oleate. In systems with butanol, minimum interfacial tensions between n-undecane and aqueous solutions of surfactant before equilibration occurred at 0.5 M NaCl, the value was about 0.015 dynes/cm. At a higher surfactant concentration (0.05 M), also in 0.5 M NaCl, a middle phase occurred in contact with n-heptane and n-octane, and much lower interfacial tensions, as low as 0.001 dynes/cm, were observed. The behavior contrasts with sodium oleate, for which the interfacial tensions were up to three orders or magnitude higher. Research on microbiological production of chemicals was concentrated on mobility-control biopolymers and alcohols, with emphasis on the glucan class of biopolymers. A continuous fermentation was carried out on bench-scale over nearly three months, with a favorable yield of about 30% polymer from feed glucose. Controlled enzyme attack on polymer appeared promising in reducing plugging, presumably by solubilization of poorly dispersed polymer aggregates, without significant loss of viscosity.Glucan polymer production by fermentation of waste or cheap carbon sources was investigated. Alcohol production by anaerobic fermentation of a number of carbohydrates by Clostridia was investigated. Several organisms gave promising yields in small-scale batch fermentations of n-butanol from carbohydrates found in waste streams.

54108 (BETC/W—26-5) **Chemicals for enhanced oil recovery. Quarterly progress report, January 1-March 31, 1979.** Compere, A.L.; Crenshaw, J.M.; Greene, S.V.; Griffith, W.L.; Hall, J.E. Jr.; Johnson, J.S. Jr.; Jones, R.M.; Magid, L.J.; Westmoreland, C.G.; Williams, D.Y. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 49p. Dep. NTIS, PC A03/MF A01.

Emphasis was on preliminary evaluation of alternative organisms for production of scleroglucan biopolymers, on procedures for separation of biopolymer from fermentation broth without precipitation or diatomaceous earth filtration, on phase and interfacial properties of derivatives of tall oils, and on testing of kraft bleach-plant effluent as a competitive adsorbate to lower loss of petroleum sulfonate surfactants on minerals.

54109 (CONS—3103-T1) **Investigations of enhanced oil recovery through use of carbon dioxide. Research progress report, July 7, 1978-March 31, 1979.** Whitehead, W.R.; Kimbler, O.K.; Holden, W.R.; Bourgoyne, A.T. (Louisiana State Univ., Baton Rouge (USA). Dept. of Petroleum Engineering). 1979. Contract ET-78-S-01-3103. 18p. Dep. NTIS, PC A02/MF A01.

The investigations of enhanced oil recovery through use of carbon dioxide are directed toward determining the exact mechanisms by which CO_2 develops miscibility with an oil during a CO_2 flood. Such studies will include the determination of how water saturation and the presence of components such as N_2, C_1, C_2, C_3, etc., in either the injected fluid or the displaced crude affect oil recovery when a CO_2 flood is employed. Primary emphasis is on displacements in sand packs and consolidated sandstone cores.

54110 (DOE/BC/20002—T1) **Ultra-low interfacial tension, phase behavior and chemical flooding processes for improved petroleum recovery. Quarterly report, July 1-September 30, 1978.** Davis, H.T.; Scriven, L.E.; Macosko, C.W.; Miller, W.G.; Prager, S. (Minnesota Univ., Minneapolis (USA). Inst. of Tech.). 1978. Contract AS19-78BC20002. 6p. Dep. NTIS, PC A02/MF A01.

Abstracts are presented of the following papers that have been published or submitted for publication: the pair and direct correlation functions of an inhomogeneous fluid; semi-empirical theory of surface tension of binary systems; on the free energy theory of inhomogeneous fluids; and an equation of state for polyatomic fluids.

54111 (DOE/BC/20002—T2) **Ultra-low interfacial tension, phase behavior and chemical flooding processes for improved petroleum recovery. Quarterly report for the period, October 1-December 31, 1978.** Davis, H.T.; Scriven, L.E.; Macosko, C.W.; Miller, W.G.; Prager, S. (Minnesota Univ., Minneapolis (USA). Inst. of Tech.). 1978. Contract AS19-78BC20002. 4p. Dep. NTIS, PC A02/MF A01.

Conclusions reached from the study, on sodium B-phenyl-n-hexadecyl-p-sulfonate and TRS 10 to 80 systems are given. Abstracts are included of the following papers: comparison of rigorous and approximate theories of inhomogeneous fluids; phase behavior of alcohol-hydrocarbon-brine mixtures; cold storage microscopy system for fast frozen liquids; polymer substrates for electron microscopy of frozen microstructured liquids; and mass loss and etching of frozen hydrated specimens.

54112 (DOE/EIA—0117/77) **World crude oil production.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 4p. NTIS, PC A02/MF A01.

World crude oil production in 1977 is given by country. 1976 data are given for comparison. Conversion factors for crude oil used in converting metric tons to US barrels of 42 gallons are given.

54113 (DOE/SF/01424—13) Big Muddy Field Low Tension Flood Demonstration Project. First annual report, April 1978-March 1979. Troiani, L.R. (Conoco, Inc., Casper, WY (USA)). Aug 1979. Contract ET-78-C-03-1424. 163p. Dep. NTIS, PC A08/MF A01.

Conoco and DOE signed a contract for a 90-acre low-tension flood demonstration to be located at the Big Muddy Field about 15 miles east of Casper, Wyoming. DOE will finance $9.5 million or about 27 percent of the total cost which includes the $4 million pilot cost. All new wells and four old wells have been completed. Five old wells in the expansion area will be plugged and abandoned. Construction work on the injection plant, production facilities, and flow lines started in November 1978, but an unusually early and severe winter curtailed this effort. Survey work has been completed for the new rail spur. Special oil saturation tests scheduled for Well No. 92 have been delayed since flow lines could not be installed as planned during this period. Laboratory work on surfactant selection has been conducted since the pilot operation. The feedstocks for the manufacture of the sulfonate that will be used in the demonstration project were identified. Work was continuing on the selection of a co-solvent and to determine the final blend and size of the surfactant slug. Polysaccharide was used in the pilot operation. Results of laboratory work indicated polyacrylamide could be both technically and economically superior to the polysaccharide if problems with oxygen-iron contamination, shear sensitivity, and bacterial control could be solved.

54114 Methods and apparatus for determining dynamic flow characteristics of production fluids in a well bore. Cubberly, W.E. Jr. (to Schlumberger Technology Corporation). US Patent 4,166,216. 28 Aug 1979. Filed date 23 Sep 1977. 16p.

In the representative embodiments of the new and improved methods and apparatus disclosed herein, a well tool incorporating the principles of the present invention is stationed in a production well and discrete quantities of a water-miscible radioactive tracer and an oil-miscible radioactive tracer are periodically discharged from spaced nozzles on the tool. By means of any of several disclosed types of fluid directors on the tool, flowing connate fluids are diverted through a restriction adjacent to the oil-miscible tracer discharge nozzle so that at least some of any oil bubbles in the connate fluids will be coalesced into larger slugs and be brought into direct contact with the ejected oil-miscible tracer. In this manner, subsequent measurements of the radioactivity level in the well bore fluids passing remote locations in the well bore will provide separate indications from which one or more of the individual dynamic flow characteristics of the produced oil and water can be determined.

54115 Methods and apparatus for determining dynamic flow characteristics of production fluids in a well bore. Anderson, R.A. (to Schlumberger Technology Corporation). US Patent 4,166,215. 28 Aug 1979. Filed date 23 Sep 1977. 18p.

In the representative embodiments of the new and improved methods and apparatus disclosed, a well tool incorporating the principles of the present invention is arranged for selectively discharging discrete minor quantities of a first radioactive tracer and of a second radioactive tracer. When the tool is stationed in a production well, upon discharge of whichever one of the two tracers that is believed to be miscible in the continuous-phase fluid at that depth location, radiation detectors arranged at spaced locations on the tool respond to provide one or more measurements of the level of radioactivity in the well bore fluids from which one or more dynamic flow characteristics of the continuous-phase fluid at that depth location may be determined.

54116 Surfactant water flooding oil recovery process. Schievelbein, V.H. (to Texaco, Inc.). US Patent 4,165,785. 28 Aug 1979. Filed date 22 Dec 1977. 10p.

The amount of oil recoverable from a subterranean, petroleum-containing, permeable formation by surfactant water flooding is improved if at least two separate slugs of surfactant-containing fluid are injected into the formation, the first being a fluid containing a surfactant which is an effective emulsifier for the petroleum in the formation and the second surfactant fluid containing a surfactant which does not produce an emulsion between the aqueous fluid and the formation petroleum, but which is effective for achieving maximum oil recovery, or for achieving the minimum interfacial tension between the aqueous phase present in the flow channels of the formation and the formation petroleum. In one embodiment, both surfactants are an aliphatic (e.g., alkyl) or alkylarylpolyalkoxyalkyl sulfonate, differing only in the average number of alkoxy groups per molecule. The first emulsifying surfactant contains an average of from 0.2 to 0.8 fewer alkoxy groups than the second surfactant.

54117 Reservoir stabilization by treating water sensitive clays. Nooner, D.W. (to Texaco, Inc.). US Patent 4,164,979. 21 Aug 1979. Filed date 30 Jun 1978. 4p.

A method is described for treating subterranean formations containing water-sensitive montmorillonite clays. It comprises contacting the formation with an aqueous solution of potassium salts of organic acids at elevated temperatures, whereby the montmorillonite is transformed into other clay minerals which are less sensitive to swelling when contacted with water.

54118 Oil extraction method. Scott, H.W. (to Winton Corporation). US Patent 4,164,978. 21 Aug 1979. Filed date 21 Feb 1978. 4p.

A method is provided for recovering oil from an oil bearing earth formation by means of electrohydraulic shock waves generated in a liquid by capacitor electrical discharge means and supplemented with ultrasonic waves.

54119 Secondary recovery process utilizing an acrylamido alkanesulfonic acid polymer. Tate, J.F. (to Texaco, Inc.). US Patent 4,163,476. 7 Aug 1979. Filed date 13 Feb 1978. 12p.

Significant improvement in the recovery of hydrocarbons from a subterranean hydrocarbon-bearing formation is accomplished by injecting into the formation via an injection well drilled into a formation communicating with an adjacent producing well and containing sandstone and clay components, and aqueous solution of an acid such as hydrochloric acid and a fluorine-containing acid or salt and having dissolved therein an oxyalkylated acrylamido alkanesulfonic acid polymer whereupon the acid solution reacts with the acid soluble components of the formation creating passageways thus facilitating the flow of fluids therein and thereby increasing the recovery of hydrocarbons from the formation through the adjacent production well.

54120 Method and apparatus for closing underwater wells. Johnson, J.L.; Vanzant, B.W. (to Sub Sea Research and Development Corp.). US Patent 4,163,477. 7 Aug 1979. Filed date 2 Mar 1978. 8p.

A method and apparatus is shown and described for remotely closing a well(s) without the possibility of accidental closure. The method and apparatus will have a significant application to underwater wells. A point of activation of a gas generator is remotely located away from the well to avoid debris that may fall at or near the well. A diver or technician brings the means for activating the gas generator to the activation point of the gas generator. Upon activation, pressure generated by the gas generator is transferred by appropriate conduit means to well closure equipment which may include a crimping device, a U type blowout preventer, blind rams or any combination thereof. The faces of rams used to pinch concentrical strings of pipe may be shaped to seal the outer strings of pipe as well as inner strings.

54121 Well locking device and method. Watkins, F.E. (to Camco, Incorporated). US Patent 4,161,984. 24 Jul 1979. Filed date 11 Sep 1978. 8p.

A well locking device and method of operation including a well lock and a landing nipple for locking well equipment in the production string of oil and/or gas wells. The well lock includes two sets of locking dogs, one of which locks the well lock in the landing nipple and holds against loads either from above or below the lock. The second set of locking dogs prevents the release of the well lock from the nipple when a pressure differential exists across the lock. A locking nipple includes first and second recesses and a stop shoulder and the coacting well lock includes a housing carrying first and second locking dogs in which the vertical spacing of the first and second locking dogs is less than the vertical distance between the tops of the first and second recesses. A seal is positioned on the exterior of the well lock housing and adapted to seal in the locking nipple, and locating means are provided on the housing for engaging the stop shoulder of the nipple. The lock can be released only by moving it downwardly and then upwardly, but any pressure below the lock sufficient to lift the lock back up after being moved downwardly will not allow the lock to be released.

54122 Method for recovering hydrocarbons. Park, J.H. (to Texaco Development Corporation). US Patent 4,161,981. 24 Jul 1979. Filed date 13 Feb 1978. 6p.

A two-step method is given for recovering hydrocarbons from a subterranean formation. In-situ combustion is first initiated in the formation by injection of air, for example, through an injection well, the injection of air is terminated and in a final step a fluid which is preferably water containing a small amount of a sulfonated interfacial tension reducer is injected into the formation whereby the fluid is heated as it passes through the hot formation and finally hydrocarbons are recovered via a production well.

54123 High conformance oil recovery process. Schievelbein, V.H. (to Texaco, Inc.). US Patent 4,161,983. 24 Jul 1979. Filed date 22 Dec 1977. 12p.

The conformance of a water flood oil recovery process, including surfactant or other chemicalized water flood process, in a formation containing at least two zones of varying permeability, the permeability of one zone being at least 50% greater than the permeability of the other zone, is improved by water flooding until the

higher permeability zone has been depleted, after which a fluid is injected into the high permeability zone, said fluid having relatively low viscosity at the time of injection and containing a particular surface-active agent which promotes the formation of a coarse emulsion in the flow channels of the formation which reduces the permeability of the high permeability zone. Since the viscosity of the fluid injected into the previously water flooded, high permeability zone is no greater than water, it is injected easily into the zone and moves through substantially the same flow channels as water would move in the formation. After the permeability of the first zone has been reduced substantially, water flooding may then be accomplished in the second zone which was originally not invaded by the injected water since its permeability was substantially less than the permeability of the first zone. The surface-active agent may be tailored to exhibit optimum emulsion formation properties with the particular aqueous fluid present in the flow channels of the formation to be treated.

54124 High conformance enhanced oil recovery process. Schievelbein, V.H.; Kudchadker, M.V.; Varnon, J.E.; Whittington, L.E. (to Texaco, Inc.). US Patent 4,161,982. 24 Jul 1979. Filed date 22 Dec 1977. 16p.

The conformance of an enhanced oil recovery process, including water flood, surfactant or other chemicalized water flood process, in a formation containing at least two zones of varying permeability, the permeability of one zone being at least 50% greater than the permeability of the other zone, is improved by flooding until the higher permeability zone has been depleted, after which a fluid is injected into the high permeability zone, said fluid having relatively low viscosity at the time of injection and containing a mixture of surfactants or surface-active agents which promote the formation of a coarse emulsion in the flow channels of the formation which reduces the permeability of the high permeability zone. Since the viscosity of the fluid injected into the previously flooded, high permeability zone is no greater than water, it is injected easily into the zone and moves through substantially the same flow channels as water would move in the formation. After the permeability of the first zone has been reduced substantially, water flooding may then be accomplished in the second zone which was originally not invaded by the injected water since its permeability was substantially less than the permeability of the first zone.

54125 Hot water foam oil production process. Dilgren, R.E.; Owens, K.B. (to Shell Oil Company). US Patent 4,161,217. 17 Jul 1979. Filed date 8 May 1979. 14p.

A relatively viscous oil is produced from a subterranean reservoir by establishing a channel of preferential permeability through the reservoir between injection and production locations, then flowing through the reservoir a hot foam of aqueous liquid, noncondensable gas and surfactant, and controlling the mobility of the foam so that heated oil is produced and hot fluid is flowed through portions of the reservoir within and outside the channel of preferrential permeability.

54126 Rocker wheel jack for an oil-well pump. Gaddy, A.K. US Patent 4,161,137. 17 Jul 1979. Filed date 14 Mar 1977. 4p.

A rocker wheel jack is arranged on a compact frame so that the driving mechanism is placed below the rocker wheel. The mechanism is adjustable so as to vary the spacing between it and a drive wheel. The rocker wheel is adjustably spaced from the drive wheel. A pitman connects the drive wheel and the rocker wheel. The pitman connections to the wheels are further adjustable radially to the wheels. Thus a jack is provided with a possibility of multiplicity of adjustments and a minimum of vertical space and of weight for the jack. The complete unit is readily movable. The driving mechanism is readily accessible for repair or replacement. An oil level sensor is provided in the well with connections transmitting its output to the rpm of the jack.

54127 Combined fracturing process for stimulation of oil and gas wells. Hussin, C. (to Canadian Fracmaster, Ltd.). US Patent 4,156,464. 29 May 1979. Priority date 21 Dec 1977, Canada, 10p.

The present invention relates to a method of forming fractures and placing proppants therein, which comprises creating a foam having a down-well Mitchell quality of form about 0.53 to 0.99 and passing that foam down the well in admixture with a particulate proppant in an amount of up to four pounds of proppant per gallon of foam, then decreasing the gas volume in said foam, whereby the proppant carrying medium being passed down the well changes from a foam to a liquid. The proppant concentration is decreased as the change occurs from foam to liquid so that the proppant material will not deposit out prematurely in the well. Once liquid flow has been established, the proppant to fluid ratio is gradually increased and the fracture of the formation is continued with liquid and proppant. The liquid is capable of carrying an amount of proppant greater than that which could be carried by the foam, namely an amount up to twelve pounds per US gallon. 3 figures.

54128 Viscous oil recovery method. Hall, W.L. (to Texaco, Inc.). US Patent 4,156,463. 29 May 1979. Filed date 26 Jun 1978. 8p.

Disclosed is a thermal oil recovery method suitable for recovering viscous oil by injecting steam and an amine compound having the following formula: $R_1R_2NR_3$, wherein R_1 and R_2 are each hydrogen or a C_1 to C_6 and preferably a C_2 to C_4 alkyl, linear or branched, and R_3 is an alkyl, linear or branched, having from 3 to 20 and preferably 4 to 12, or R_3 is $-R_4NH_2$ wherein R_4 is a C_2 to C_{18} alkyl, linear or branched, and preferably 3 to 11, the sum of carbon atoms in R_1, R_2 and R_3 being from 3 to 20 and preferably from 7 to 13. The amine and steam may be mixed and injected into the formation, or one or more slugs of amine may be injected sequentially with steam injection. The amine improves the overall oil recovery and thermal efficiency of a steam flooding oil recovery process by improving the separation of viscous oil from the formation mineral surfaces. 1 table.

54129 Hydrocarbon recovery process. Allen, J.C. (to Texaco, Inc.). US Patent 4,156,462. 29 May 1979. Filed date 23 Jan 1978. 6p.

A two-step process for recovering hydrocarbons from a subterranean formation in which the formation is first heated by injecting steam at a temperature of about 500° to about 1500°F through an injection well and in a second step a mixture of carbon monoxide and hydrogen is pressured into the formation via the injection well where in the heated formation reaction with the carbon monoxide and steam takes place forming additional hydrogen and carbon dioxide and finally hydrocarbons are recovered via a production well. Optionally, after injection of the mixture of carbon monoxide and hydrogen into the formation has been terminated, the heat stored in the formation may be recovered by injecting water, as a drive fluid into the formation via the injection well. The injected water may contain a small amount of a sulfated interfacial tension reducer.

54130 Sulfide monitoring system and method. Zetter, M.S. (to Dalphian Corp.). US Patent 4,154,659. 15 May 1979. Filed date 30 Aug 1977. 24p.

Methods and apparatus relating to systems for determination of sulfide species and hydrogen sulfide hazard potential of well drilling mud. 6 figures.

54131 Overview of selected oil recovery processes. Johansen, R.T. (Bartlesville Energy Technol Cent, Okla). *J. Rheol.;* **23**: No. 2, 167-179(Apr 1979).

The two major difficulties in producing petroleum from subsurface formations by fluid injection are poor displacement efficiency and poor sweep efficiency. Engineering and chemical means are being investigated to improve the performance of these recovery controlling processes. Interfacially active compounds suitable for oilfield application now are available for use. Similarly, polymers of various kinds also are available in quantities sufficient for use in petroleum recovery. The utilization of these kinds of materials is discussed together with the desired effects and limitation of their use for oil recovery purposes. The chemical and physical principles of the newest enhanced oil recovery processes that are currently under development by the government and the petroleum industry are discussed. 5 refs.

54132 (NP—23881) Petroleum and natural gas: new technologies of prospection and extraction. (Wirtschaftsverband Erdoel- und Erdgasgewinnung e.V., Hannover (Germany, F.R.)). [nd]. 23p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

After comparing the balances of the German petroleum and natural gas industries for the years 1973 and 1977, methods to extract petroleum from the deposits are described. Petroleum extraction by chemical flooding is described in some detail.

PROCESSING

REFER ALSO TO CITATION(S) 54147, 54148

54133 Process for suppression of hydrogenolysis and C/sub 5$^+$/ liquid yield loss in a cyclic reforming unit. Swan, G.A. (to Exxon Research and Engineering Co.). US Patent 4,166,024. 28 Aug 1979. Filed date 10 Jul 1978. 14p.

A process is described for reforming naphtha, with hydrogen, in a cyclic reforming unit which contains a plurality of catalyst-containing on-stream reactors in series, and a catalyst-containing swing reactor manifolded therewith which can be periodically placed in series and substituted for an on-stream reactor while the latter is removed from series for regeneration and reactivation of the catalyst contained therein. In the process, the ability of a catalyst to operate in a hydrogenolysis mode and effect sulfur release can be effectively suppressed after the freshly prepared catalyst has been regenerated, and reactivated several times, generally about five times or more, by the addition thereto of sufficient sulfur to maintain an equilibrium amount of sulfur on the catalyst, preferably a maximum

of about 0.01 wt % sulfur. Preferably, a modified catalyst presulfiding regimen is imposed wherein the amount of sulfur added to a fresh catalyst is progressively, and preferably proportionately reduced from one regeneration, reactivation sequence to the next such that, on and after about the fifth regeneration, and reactivation of the catalyst a maximum of about 0.01 wt % sulfur is added to the catalyst. In a preferred mode of operation, the catalyst of the lead reactors of the series is not directly sulfided, but indirectly sulfided by sulfur added to, and released by the tail reactor, or reactors. An on-stream water wave displaces sulfur from the sulfided catalyst of the tail reactor, or reactors, as it is returned to service, and a water wave from the catalyst of each reactor redistributes sulfur to under-sulfided catalysts of other reactors in the form of hydrogen sulfide released to and carried by the recycle gas.

54134 Hydrocarbon conversion with a superactive multimetallic catalytic composite. Antos, G.J. (to UOP Inc.). US Patent 4,165,276. 21 Aug 1979. Filed date 14 Sep 1977. 26p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with a novel superactive multimetallic catalytic composite comprising a combination of a catalytically effective amount of a pyrolyzed rhenium carbonyl component with a porous carrier material containing a uniform dispersion of a catalytically effective amount of a platinum group component which is maintained in the elemental metallic state. In a highly preferred embodiment, this novel catalytic composite also contains a catalytically effective amount of a halogen component. The platinum group component, pyrolyzed rhenium carbonyl component and optional halogen component are preferably present in the multimetallic catalytic composite in amounts, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt % platinum group metal, about 0.01 to about 5 wt % rhenium and about 0.1 to about 3.5 wt % halogen. A key feature associated with the preparation of the subject catalytic composite is reaction of a rhenium carbonyl complex with a porous carrier material containing a uniform dispersion of a platnium group metal maintained in the elemental state, whereby the interaction of the rhenium moiety with the platinum group moiety is maximized due to the platinophilic (i.e., platinum-seeking) propensities of the carbon monoxide ligand used in the rhenium reagent. A specific example of the type of hydrocarbon conversion process disclosed is a process for the catalytic reforming of a low octane gasoline fraction wherein the gasoline fraction and a hydrogen stream are contacted with the subject superactive multimetallic catalytic composite art reforming conditions.

54135 Hydrocarbon cracking with catalyst containing a CO oxidation promoter in ultra-stable zeolite particles. Gladrow, E.M. (to Exxon Research and Engineering Co.). US Patent 4,164,465. 14 Aug 1979. Filed date 3 Feb 1978. 12p.

A cracking catalyst for promoting the oxidation of carbon monoxide to carbon dioxide during regeneration of the catalyst by the burning of coke therefrom, comprises two distinct crystalline aluminosilicate zeolite particles embedded in an inorganic porous oxide matrix material. The first zeolite is the ultra-stable variety of Y-type zeolite which contains a CO oxidation promoter, such as a Group VIII metal or compound thereof. The second zeolite is a rare earth metal-containing zeolite. A preferred catalyst comprises an ultrastable Y-type zeolite containing Pt and/or Pd and a rare earth metal exchanged X- or Y-type zeolite, which zeolites are embedded in a silica-alumina or clay matrix.

54136 Sequential hydrocracking and hydrogenating process for lube oil production. Stangeland, B.E. (to Chevron Research Company). US Patent 4,162,962. 31 Jul 1979. Filed date 25 Sep 1978. 6p.

The uv-unstable hydrocrackate lube oil stock is improved by hydrogenating the stock at a temperature in the 200° to 300°C range using a hydrogenating component disposed upon an alumina carrier having a substantial pore volume of which a major portion is in pores having diameters in the 80- to 150-Angstrom range.

54137 Combination process for octane upgrading the low-octane C_5-C_6 component of a gasoline pool. Miller, S.J. (to Chevron Research Company). US Patent 4,162,212. 24 Jul 1979. Filed date 30 Aug 1978. 8p.

Low-octane C_5-C_6 gasoline pool mixtures or components are upgraded into improved-octane gasoline blendstock by (1) catalytically converting a minor yet significant portion of the C_6-fraction into a relatively high-octane stock using a unique crystalline aluminosilica zeolite catalyst, (2) isomerizing the C_5-fraction plus the remainder of the C_6-fraction, and (3) blending the converted C_6-portion with the C_5-C_6 isomerizate.

54138 Thermal desulfurization and calcination of petroleum coke. Hardin, E.E.; Guffey, D.H.; Grindstaff, L.I. (to Great Lakes Carbon Corporation). US Patent 4,160,814. 10 Jul 1979. Filed date 1 Mar 1978. 6p.

Low sulfur calcined coke is produced from high sulfur raw coke without substantially lowering its bulk density by heating the coke at a first temperature such that no more than about 70 wt % of the volatile matter is removed therefrom and then heating the partially devolatilized coke at a higher temperature sufficient to effect calcination and desulfurization.

54139 De-sulfurization of petroleum residues using melt of alkali metal sulfude hydrates or hydroxide hydrates. Swanson, R. US Patent 4,160,721. 10 Jul 1979. Filed date 20 Apr 1978. 6p.

Petroleum residues are reduced in sulfur content by intimately contacting one volume of petroleum residue with at least 0.25 volume of alkali metal sulfide hydrate melt, or alkali metal hydroxide hydrate melt or mixtures thereof, within a closed system, at a temperature between 120°C and 325°C, for from 3 to 60 min. The de-sulfured petroleum residue is then separated from the alkali metal sulfide hydrate melt by a hot liquid-liquid separation; thereafter the separated alkali metal sulfide hydrate melt is used to de-sulfur additional petroleum residue.

54140 Catalyst for removing sulfur from a gas. Blanton, W.A. Jr.; Flanders, R.L. (to Chevron Research Company). US Patent 4,152,298. 1 May 1979. Filed date 26 Jan 1978. 28p.

Sulfur oxides are removed from a gas, and the sulfur is converted to hydrogen sulfide by the steps of: (1) reacting sulfur oxides in the gas with alumina to form a solid sulfur-containing compound and remove sulfur oxides from the gas; and (2) contacting the solid compound resulting from step (1) with a hydrocarbon at a temperature of about 800° to 1300°F and reacting the solid sulfur-containing compound with components of the hydrocarbon to form hydrogen sulfide.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 55078, 55087

54141 (DOE/EIA—0102/3) Projected 1985 automobile gasoline savings from the House-passed gas guzzler tax and Conference minimum mileage standards. Analysis Memorandum AM/EU-7802. Emerson, F.; Walton, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 42p. NTIS, PC A03/MF A01.

An analysis is presented of the potential 1985 impacts from the House-passed gas guzzler tax and the Conference minimum mileage standards. Two alternative methodologies were employed for the purpose of this analysis. One approach used the DOE Faucett model. The other used DOT projections of the automobile manufacturers' capabilities to meet EPCA new car economy standards based on data obtained from the manufacturers.

54142 High carbon content liquid fuels. Hughes, L.; Robinson, K.R.; Deviney, M.L. Jr. (to Ashland Oil, Inc.). US Patent 4,165,969. 28 Aug 1979. Filed date 11 Oct 1978. 6p.

Disclosed is a high-carbon-content liquid hydrocarbon fuel wherein particulated carbon such as carbon black, having organic groups or components attached to the surfaces thereof, is dispersed in a liquid hydrocarbon fuel. Disclosed also is a method for making the high-carbon-content liquid hydrocarbon fuel wherein organic components are graft-polymerized to carbon black dispersed in a liquid hydrocarbon fuel.

54143 Emulsifier blend and aqueous fuel oil emulsions. Yount, J.B. III. (to ICI Americas Inc.). US Patent 4,162,143. 24 Jul 1979. Filed date 13 Mar 1978. 16p.

The present invention is directed to water-in-oil type fuel oil emulsions which are particularly useful in firing boilers in ships, locomotives and industrial power plants. Furthermore, the invention is directed to aqueous particulate slurries dispersed in fuel oil. Specifically, the invention is directed to aqueous/oil slurries of combustible or noncombustible particulate having improved burning characteristics. Of specific interest are stable aqueous/oil slurries of coal dust. These emulsions and slurries are achieved through the use of a novel blend of cationic, nonionic and anionic surfactants to which the invention is also directed.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 55623

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54132, 55080, 55088, 55089, 55090

54144 (DOE/EIA—0102/1) Fact sheet: forecasted automobile gasoline consumption. Analysis memorandum, AM/EU-7801. (Depart-

ment of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 13p. NTIS, PC A02/MF A01.

The system used for projecting automotive gasoline consumption and efficiency which was used for the EIA Annual Report to Congress made use of historical data on fuel efficiency, together with specific projections of gasoline prices and major macroeconomic variables. Projected new-car efficiency was based upon the assumption that manufacturers would attempt to minimize the sum of the manufacturing costs arising from improved efficiency and civil penalties associated with not meeting EPCA efficiency standards. In Volume II of this report, estimated on-road efficiencies were calculated by applying a constant degradation factor to efficiencies as measured on the basis of EPA tests. This yields an on-road efficiency of about 21 mpg in 1985. In an analysis which has been done since release of the report, a new set of empirically estimated degradation factors was used to estimate the on-road new car efficiencies and gasoline consumption which would be consistent with meeting EPCA standards. This resulted in estimates of future on-road efficiencies during the mid-1980's which are generally somewhat higher than those used in the report's analysis. Automobile gasoline consumption was estimated by using the new set of degradation factors to project the range of consumption levels which may be achieved by meeting EPCA standards through 1985. It was found that the automotive gasoline consumption for the 1978 to 1985 period which was projected in the report was within the range of estimates resulting from the application of the new degradation factors.

54145 (DOE/EIA—0102/9) **Examination of several world oil price scenarios given exogenous supply and demand estimates. Analysis Memorandum No. AM/IA/78-21.** Kilgore, W.C.; Rodekohr, M. (Department of Energy, Washington, DC (USA). Energy Information Administration). 31 Jul 1978. 52p. NTIS, PC A04/MF A01.

An analysis of future world oil prices is documented. The analysis is based on estimates of world oil supply and demand provided by the Senate Energy and Natural Resources Committee and uses the latest Energy Information Administration (EIA) price, income, and economic feedback elasticities to forecast market clearing world oil prices for a number of different scenarios. The assumptions critical to the analysis are: the specification of the base supply and demand paths provided by the Senate Committee; the OPEC production limits as specified by the Office of International Affairs (Department of Energy); and the EIA elasticity estimates which were derived from previous simulations of the PIES, IEES, and DRI macroeconomic models.

54146 (DOE/EIA—0102/13) **Assessment of potential US petroleum supply shortfalls, 1978 to 1990. Analysis Memorandum AM/IA/78-25.** Butler, D. (Department of Energy, Washington, DC (USA). Energy Information Administration). 15 Sep 1978. 38p. NTIS, PC A03/MF A01.

An assessment of potential US petroleum supply shortfalls for the period 1978 to 1990 is based upon scenarios defined by the Department of Energy, International Affairs, in a June 19, 1978 memorandum entitled Supply Disruption Scenarios. The Energy Information Administration's (EIA) Oil Market Simulation model was used to quantify the oil price increases that would be necessary to constrain world demand for OPEquantity the oil oil to not exceed EIA's most optimistic estimates of OPEC production capacity. The EIA projection series have been modified to reflect the likelihood of constrained world oil supplies in the 1980s and associated increases in oil prices required to balance world supply and demand. The resulting modified versions of Projection Series C and D are referred to as Projection Series G and H, respectively. The new supply and demand projections were then used as the basis for calculating supply shortfalls using the Petroleum Allocation (PAL) model. A total of five disruption scenarios were simulated for the years 1978, 1980, 1985, and 1990 using the PAL model. The expected supply shortfalls to the United States resulting from each of these cases are summarized. The potential shortfalls vary significantly over the five disruption scenarios, ranging between 1.7 and 6.0 million barrels per day for the year 1978. However, the potential shortfalls are not expected to increase significantly during the 1980's. The estimates for 1990 increase to be between 2.0 and 6.8 million barrels per day. The principal reason for this relative stability of the projections over time is the assumed constraint on the future availability of OPEC oil even before any supply disruption occurs. This limited OPEC supply results in increasing prices of world oil, reduced demand growth, and only slight increases in the exposure of the industriaized countries to disruptions in the supply of Arab oil.

54147 (DOE/RA—0010(79)) **Trends in refinery capacity and utilization.** Peer. E.L.; Marsik, F.V.; Hutchins, J.F. (Department of Energy, Washington, DC (USA). Office of Oil and Natural Gas Supply Development). Sep 1979. 77p. Dep. NTIS, PC A06/MF A01.

Purpose of this report is to examine United States and foreign crude oil refining capacities. Specifically, the report examines the growth of foreign capacity capable of exporting products to the United States. This data is compared with the growth of refinery capacity in the United States, to yeild an overall perspective on the product import situation.

WASTE MANAGEMENT

54148 (CONF-7906120—1) **Use of granular acivated carbon to remove trace organics from the effluent of a Class-B refinery: a case study.** Flotard, R.D.; Ford, D.L.; Harrison, W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 7. annual industrial pollution conference; Philadelphia, PA, USA (5 Jun 1979).

A recent study by Raphaelian and Harrison (1978) at SOHIO's Toledo refinery demonstrated that the activated sludge biological treatment system reduced concentrations of trace organic compounds in the waste water by over 99%. Addition of a pilot-scale mixed media filter and granular activated carbon (GAC) filter produced additional removals ranging from 12 to 98% for those compounds that could be quantified. The estimated cost of adding a full-scale GAC system to the SOHIO refinery is $6,800,000. The yearly operational cost for an 8.6 MGD flow is $1,720,000, including amortization, and the annual energy requirement is estimated at 12.775×10^6 kwh(e); this is equivalent to 2.2×10^4 bbl crude oil, or 0.0503% of average annual refinery throughput.

54149 **Method of rerefining oil by dilution, clarification and extraction.** Forsberg, J.W. (to Lubrizol Corp.). US Patent 4,154,670. 15 May 1979. Filed date 10 Jan 1977. 4p.

Used oil is rerefined by diluting it with a non-polar diluent, removing insoluble impurities from the resulting solution, extracting said solution with an immiscible liquid extractant to remove further impurities, and finally removing extractant and diluent from the oil.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 55553, 55576

54150 **Oil recovery method and apparatus.** Bennett, J.A.; McAllister, I.R.; Welsh, H. (to Bennett Pollution Controls Ltd.). US Patent 4,165,282. 21 Aug 1979. Filed date 5 Dec 1977. 14p.

An oil recovery device is designed with a downwardly and rearwardly traveling oil absorbing belt, to pick up oil on a body of water. The belt travels around an upwardly and forwardly positioned drum to be engaged by a porous squeeze belt to remove the oil from the oil absorbing belt. Rearwardly of the belt is an oil collecting enclosure to collect oil not recovered by the oil absorbing belt. The device has a downwardly and rearwardly inclined bow ramp over which an oil/water liquid passes into a through passage in the device, and water having oil separated therefrom passes out longitudinally spaced bottom openings, with the flow through these openings being controlled by closure doors.

54151 **Apparatus to facilitate burning of a layer of oil, particularly oil spills.** Tokarz, R.D. US Patent 4,154,684. 15 May 1979. Filed date 26 Aug 1977. 6p.

Apparatus for facilitating the burning of an oil spill in-situ is described which utilizes a plurality of closely associated floating facilitors. The facilitators are constructed of a highly insulative and porous material for subdividing the oil spill into separably definable oil columns that are substantially thermally insulated from the body of water to minimize heat transfer between the body of water and the oil spill. 6 figures.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 54141

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 55168

PROPERTIES

REFER ALSO TO CITATION(S) 54059

54152 (BETC—001-3) **Characterization of high boiling fossil fuel distillates via ^1H and ^{13}C NMR analysis. Quarterly report III, January 1, 1979-March 31, 1979.** Berlin, K.D.; O'Donnell, D.J.; Sigle, S. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemis-

try). 1979. Contract EW-78-S-19-0001. 30p. Dep. NTIS, PC A03/MF A01.

The main goal achieved this quarter was the successful completion of the ^{13}C NMR analysis of the diaromatic fractions of Wilmington (211-76; 16, 19 and 22) and Gach Saran (207-76; 15, 22 and 24) high boiling (535 to 675°C) distillates. The analysis of additional samples supplied by DOE at our request, as well as the remainder of the samples submitted under the original contract, is currently underway. We have found from initial observations of the polyaromatic-polar fractions that the analysis time per sample must be increased to 84 h in order to obtain reliable data.

COMBUSTION

REFER ALSO TO CITATION(S) 54062

NATURAL GAS

REFER ALSO TO CITATION(S) 55107, 55126

GEOLOGY AND EXPLORATION

54153 (METC/EGSP—13) **Black shale and sandstone facies of the Devonian Catskill clastic wedge in the subsurface of western Pennsylvania.** Piotrowski, R.G.; Harper, J.A. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey). 1979. Contract EY-76-S-05-5198. 391p. Dep. NTIS, PC A17/MF A01.

This document includes 39 maps which present structural, isopach, and lithofacies data. Twenty-two of these maps are based on the Upper and Middle Devonian radioactive black shales and their associated lithologies; the remaining 17 maps deal with the Upper Devonian sandstone zones and intercalated shale zones. (DLC)

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 54105, 54114, 54120, 54158

54154 Method and apparatus for handling the fluids in a two-phase flow pipeline system. Martin, R.E.; Hagan, E.P. Jr. (to Texas Eastern Engineering, Ltd.). US Patent 4,160,652. 10 Jul 1979. Filed date 26 Aug 1977. 20p.

A method and apparatus for handling the fluids in a two-phase flow pipeline system are described. The gas-liquid flow stream is fed into a separator in which the gas is separated from the liquid. The gas is removed upwardly from the separator through a control valve. The liquid is removed downwardly from the lower portion of the separator. The liquid level in the separator is detected, and a controller effects opening or closing of the control valve whereby the rate of flow of the liquid out of the separator is controlled. An elongated accumulator is in fluid communication with both the liquid outlet of the separator and the outlet of the control valve. The liquid flowing out of the separator is fed into the elongated accumulator loop which has previously been filled with gas. A free piston is positioned in the accumulator loop ahead of the liquid to separate the accumulated liquid from the gas in the accumulator loop. When a quantity of liquid has been transferred to the accumulator loop, selected valving is operated to supply pressure from a pressurized gas source, such as, the discharge pipeline of a gas compressor station, to the gas side of the free piston in the accumulator loop to drive the accumulated liquid back out of the accumulator loop and into a pipeline system, such as, the discharge pipeline of the compressor station.

54155 Method for separating carbon dioxide from methane. Trentham, H.L.; Hegwer, A.M. (to Trentham Corporation). US Patent 4,152,129. 1 May 1979. Filed date 4 Feb 1977. 10p.

A method is disclosed whereby carbon dioxide and methane in a gaseous mixture can be separated with little energy consumption when the gaseous mixture contains large amounts of carbon dioxide, i.e., from about 30 to about 90 mol %. The method involves the fractionation of the gas mixture at a pressure below the critical pressure of the mixture and at a temperature above the triple point temperature of the mixture.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54132, 55089

54156 (DOE/EIA—0045(76)) **Statistics of interstate natural gas pipeline companies, 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1978. 267p. NTIS, PC A12/MF A01.

Financial and operating statistics compiled from annual reports filed with the Federal Power Commission by Classes A and B interstate natural gas pipeline companies for the year ending December 31, 1976, are presented. Classes A and B include interstate natural gas pipeline companies with annual gas operating revenues of $1,000,000 or more.

54157 (DOE/EIA—0102/10) **Further evaluation of natural gas pricing proposals. Analysis Memorandum AM/IA/78-17.** Murphy, F.H. (Department of Energy, Washington, DC (USA). Energy Information Administration). 31 Jul 1978. 18p. NTIS, PC A02/MF A01.

This paper presents an extension of the previous Energy Information Administration analysis of the impact of several natural gas pricing proposals currently before the Congress, as compared to continued current regulations on natural gas markets. The principal new focus is on a different assumption about the way natural gas is priced to consumers under the Senate bill (H.R. 5289). The earlier analysis used the assumption that incremental pricing provisions legally imposed on interstate pipelines would be passed through by distribution companies to users. This analysis uses the assumption that the incremental pricing provisions do not go beyond the pipeline, and that prices of new supplies are rolled-in. The two analysis may be regarded as giving upper and lower limits to the actual outcome, which presumably would entail some roll-in and some passthrough, rather than being 100% one way or the other. The only significant impacts of changing the assumptions regarding downstream pricing provisions in the Senate bill are: changes in projected sectoral prices; and related projected sectoral volumes of consumption. The effect of assuming rolled-in pricing for the Senate bill as opposed to incremental pricing is to raise the gas price to the residential sector and lower it to the commercial, industrial, and raw material sectors. Except for the commercial sector, all retail gas prices under the rolled-in version of the Senate bill are higher than under the compromise proposal. Under this assumption the estimated impact of the compromise proposal is a projected residential price that is higher than that for the House bill, but lower than that for the Senate bill assuming rolled-in pricing.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 54127

54158 (TID—28848(DRAFT)) **Commercialization strategy report for recovery of natural gas from unconventional sources.** Ham, J.; Atkinson, S.E.; Dewey, L. (Department of Energy, Washington, DC (USA)). 1978. 90p. Dep. NTIS, PC A05/MF A01.

Tight gas sands and Devonian shale are ready for commercialization, although higher than historical gas prices, improved recovery technology, and an aggressive commercialization program are required to fully develop these resources. Coalbed methane for local (non-pipeline) markets appears ready for commercialization for the local (self-help) industrial or municipal market. Coalbed methane for pipeline markets does not appear ready for commercialization in the near term due to highly uncertain geologic properties, economic uncertainties, perceived safety hazards, and limited interest by mine operators. Geopressured aquifers do not appear ready for commercialization in the near term because of vast geologic, technical, and environmental uncertainties and high production costs. Given a gap in domestic supplies to 6 to 8 Tcf in 1990, gas from the unconventional, domestic sources could fill 3 to 6 Tcf of this gap.

54159 (UCRL—82456) **Effects of mechanical and frictional rock properties on hydraulic fracture growth near unbonded interfaces.** Anderson, G.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1979. Contract W-7405-ENG-48. 17p. (CONF-790913—7). Dep. NTIS, PC A02/MF A01.

From 54. annual technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

Experiments are being performed to study the growth of hydraulically driven cracks in the vicinity of an unbonded interface in rocks. The materials on either side of the interface may be the same or different. The materials used in these studies are Nugget sandstone from Utah (3-6% porosity) and Indiana limestone (12-15% porosity). The fracturing fluid is oil which is injected into the test specimens through high pressure steel tubing. Blocks of the rock materials which are to be studied are held adjacent to one another in a hydraulic press so that a normal stress is set up across their mutual interface. A hydraulically driven crack is initiated in one of the blocks. It is found that the major parameters which affect hydraulic crack penetration into the adjacent block are the relative values of the mechanical strength and moduli of the rocks on either side of tl

interface, the finish of the interface surfaces, and the magnitude of the normal stress across the interface. To gain a better understanding of the mechanisms which control the growth of cracks across the interfaces, experiments are being performed to study the frictional properties of these interface surfaces. The experiments involve the simultaneous measurement of the normal force across the interface and the applied force necessary to overcome friction to initiate displacement. These experiments indicate that in addition to the normal force, the frictional force depends upon the surface finish and the presence of water in the rock. 10 figures.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 55091

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 54156, 55092, 55093, 55094, 55168

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

54160 (METC/CR—79/27) **X-radiograph atlas of lithotypes and other structures in the Devonian shale sequence of West Virginia and Virginia.** Nuhfer, E.B.; Vinopal, R.J.; Klanderman, D.S. (West Virginia Geological and Economic Survey, Morgantown (USA)). Aug 1979. Contract EY-76-C-05-5199. 49p. Dep. NTIS, PC A03/MF A01.

X-radiographs of 525 samples from cored wells and outcrops serve as the basis for a study of fabric elements in the Upper Devonian shale sequence of West Virginia and Virginia. Four shale lithotypes have been identified from X-radiographs: (1) thinly-laminated shale, (2) lenticularly-laminated shale, (3) sharply-banded shale, and (4) non-banded shale. The order from 1 to 4 follows decreasing lateral fabric continuity. Two non-shale lithotypes, siltstones and concretions are also recognized. Gas production from this shale section is associated with lithotypes possessing high lateral fabric continuity. Thus, a classification based on fabric elements appears useful both for interpretation of depositional environments and for interpretation of reservoir properties. Forty-nine illustrations of lithotypes, other sedimentary structures, and tectonic features are given.

DRILLING, FRACTURING, AND MINING

54161 (SAND—79-0582C) **Bed preparation concepts for true in situ oil shale processing: an evaluation of current technology.** Boade, R.R.; Stevens, A.L.; Harak, A.E.; Long, A. (Sandia Labs., Albuquerque, NM (USA); Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). 1979. Contract EY-76-C-04-0789. 18p. (CONF-790913—1). Dep. NTIS, PC A02/MF A01.

From 54. annual technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

True in situ methods to process oil shale, which by definition require no mining and depend on wellbores for access to the underground formation, will be successful only if techniques are available to transform the normally very tight oil shale seams into rubble beds that are sufficiently porous and permeable and composed of suitably sized fragments to permit effective retorting operations to be conducted. Prior experimental efforts to create such beds in comparatively deep formations, where significant void cannot be introduced by explosively lifting the overburden, have in nearly all cases employed either the wellbore springing or hydraulic/explosive fracturing concept. Only very limited success has ever been achieved in these efforts. In this paper, reasons for the lack of success are identified. For the wellbore springing concept, the inherent cylindrical geometry is the primary difficulty in that it leads to small fractured zones because of rapid stress pulse attenuation, and also to regions of residual compressive stress around the wellbores which restrict fluid flow and hinder void redistribution. Major difficulties with the hydraulic/explosive fracturing concepts are that many important operations cannot be controlled and that regions of enhanced permeability are formed only in the immediate vicinity of explosive filled hydrofractures. The future success of true in situ processing depends on the introduction of void prior to the blasting operation and deployment of explosive in a geometry that will ensure distribution of the void.

OIL PRODUCTION, RECOVERY, AND REFINING

54162 **Process and apparatus to produce synthetic crude oil from tar sands.** Seader, J.D.; Jayakar, K.M. (to University of Utah). US Patent 4,160,720. 10 Jul 1979. Filed date 15 Dec 1977. 12p.

A process and apparatus for producing synthetic crude oil from bitumen-bearing sands is described. The apparatus includes a vessel segregated into a pyrolysis zone and a combustion zone, each zone being in the form of a fluidized bed reactor. At least one heat pipe is provided for transferring thermal energy from the combustion zone to the pyrolysis zone where the thermal energy is used to pyrolyze the bitumen. The apparatus may also include additional heat exchange equipment for heating the incoming combustion air for the combustion zone. The combustion air serves as the fluidizing medium for the fluidized bed reactor of the combustion zone while flue gases from the combustion zone serve as the fluidizing medium for the fluidized bed reactor of the pyrolysis zone.

54163 **Method and apparatus for acquisition of shale oil.** Grow, H.B. US Patent 4,151,067. 24 Apr 1979. Filed date 6 Jun 1977. 6p.

Emulsified shale oil is obtained from oil shale by first granulating the shale and then admixing an emulsifier (water) with the ground shale. The mixture is then subjected to sonic vibration for the intimate comingling of the fluid admixture to induce separation of the shale oil from the particulate material.

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 54161

54164 (FE—2346-44) **Energy from the situ processing of antrim oil shale. Quarterly technical progress report, January-March, 1979.** Washington, L.J. Jr. (Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Dept.). 20 Mar 1979. Contract EX-76-C-01-2346. 45p. Dep. NTIS, PC A03/MF A01.

Permeability studies on the 100 series wells, which had been hydraulically and then explosively fractured, have shown much greater communication between wells and much greater permeability than had been present in the wells on the existing site during the 1978 extraction trials. Well # 301, which is the central well in the explosive underreaming series, was cleaned out. Two wells were drilled and cored nearby. Extensive fracturing due to the use of explosives in Well # 301 was evident in the well located 15 feet from the site of the explosive treatment. Communication between these wells is also evident. A downhole methane burner of Tejas Petroleum Engineers was successfully tested under realistic operating conditions in an existing well. Other preparations for the planned extraction trial are continuing.

54165 (SAN—1787-T1) **Investigation of the geokinetics horizontal in situ oil shale retorting process. Quarterly report, October-December 1978.** Mankowski, S.G. (Geokinetics, Inc., Concord, CA (USA)). Mar 1979. Contract ET-78-F-03-1787. 229p. Dep. NTIS, PC A10/MF A01.

Site preparation, drilling and blasting, and retort preparation and burn are reported. During the quarter, 1,754 bbl of shale oil were sold to DOE and shipped to Anvil Points. The post-blast, preburn coring was completed on Retort No. 18. Environmental research (water, air, ecology, etc.) is reported.

54166 **Mine enhanced hydrocarbon recovery technique.** Cobbs, J.H. US Patent 4,165,903. 28 Aug 1979. Filed date 6 Feb 1978. 8p.

A method of extracting viscous hydrocarbon from an underground strata is described. The method comprises the steps of forming a vertical access hole from the earth's surface to a point below the strata, the diameter of the access hole being sufficient to permit passage of workmen and machinery, mining an elongated horizontal shaft from the vertical access hole under the strata, establishing at least one drilling station in the horizontal shaft, drilling upwardly from the drilling station a plurality of wells into the hydrocarbon strata, the wells being spaced apart and preferably drilled so as to be substantially vertical in the hydrocarbon strata, injecting a viscosity reducing agent into one or more of the wells to reduce hydrocarbon in the strata to free flowing liquid, withdrawing the free flowing hydrocarbon from the strata through one or more of the wells, and pumping the withdrawn hydrocarbon to the earth's surface.

54167 **Determining the locus of a processing zone in an in situ oil shale retort.** Cha, C.Y.; Bartel, W.J. (to Occidental Oil Shale, Inc.). US Patent 4,163,475. 7 Aug 1979. Filed date 21 Apr 1978. 16p.

A processing zone advances through a fragmented permeable mass of particles containing oil shale in an in-situ oil shale retort in a subterranean formation containing oil shale. The fragmented mass has layers of formation particles of differing composition, such as kerogen content, corresponding to strata of differing composition in the formation. The processing zone advances in a direction substantially perpendicular to such layers in the fragmented mass. Kerogen

in oil shale is decomposed to produce gaseous and liquid products including shale oil, and shale oil is withdrawn from the retort. At least one characteristic of the shale oil withdrawn from the retort varies in response to differences in composition of such layers of formation particles through which the processing zone advances. Such a characteristic can be a physical property of the shale oil such as viscosity or specific gravity, or a chemical property such as sulfur content or trace metal content. To determine the locus of the processing zone with respect to such layers in the fragmented mass, formation is analyzed for defining the locus of at least one such layer in the fragmented mass before retorting, and shale oil withdrawn from the retort is monitored for variation of such a characteristic corresponding to advancement of the processing zone through such a layer in the fragmented mass.

54168 In-situ retorting of carbonaceous deposits. Kvapil, R.; Clews, K.M. (to Gulf Oil Corporation). US Patent 4,162,808. 31 Jul 1979. Filed date 23 May 1978. 8p.

A method of producing fluid fuels from carbonaceous deposits such as oil shale, heavy oils and coal by in-situ retorting of the carbonaceous deposit in rubblized in-situ retorts utilizes a plurality of such retorts. The retorts are subjected to a sequence of preparation for rubblization, rubblization and combustion of carbonaceous material to supply heat to produce a fluid fuel from kerogen in the carbonaceous deposit. At least one completely rubblized retort is maintained throughout its entire volume under the inlet pressure of the combustion air between retorts in which rubblization or stopping is taking place and retorts in which the combustion of the carbonaceous deposit is proceeding to prevent flow of toxic gases from the retort in which combustion is proceeding to a retort in which preparation for rubblization and rubblization are occurring. The invention is described in detail for the recovery of shale oil from oil shale deposits.

54169 Determining the locus of a processing zone in an oil shale retort by monitoring pressure drop across the retort. Cha, C.Y. (to Occidental Oil Shale, Inc.). US Patent 4,162,706. 31 Jul 1979. Filed date 12 Jan 1978. 16p.

A processing zone advances through a fragmented permeable mass of particles containing oil shale in an in-situ oil shale retort in a subterranean formation containing oil shale. The retort has an inlet gas introduced thereto and an effluent gas withdrawn therefrom. To determine the locus of the processing zone, kerogen content of formation at selected locations in the retort is determined before processing the selected locations. Because the difference in pressure between the inlet gas and the effluent gas increases as the kerogen content of formation being processed increases, changes in pressure drop across the fragmented mass can be predicted. By comparing actual changes in pressure drop with predicted change in pressure drop, the locus of the processing zone can be determined.

54170 Decreasing hydrocarbon, hydrogen and carbon monoxide concentration of a gas. Cha, C.Y. (to Occidental Oil Shale, Inc.). US Patent 4,156,461. 29 May 1979. Filed date 16 Dec 1977. 12p.

The concentration of hydrocarbons, hydrogen, and carbon monoxide in a gas is reduced by combining these constituents in the gas with oxygen in the presence of a fragmented permeable mass of particles containing oil shale treated to remove organic materials. 1 figure, 1 table.

54171 Recovery of fluid fuels by in-situ retorting of carbonaceous deposits. Kvapil, R.; Clews, K.M. (to Golder Associates, Inc.). US Patent 4,153,300. 8 May 1979. Filed date 23 May 1978. 8p.

In-situ retorts of elongated rectangular shape in horizontal cross section are constructed in subsurface carbonaceous deposits in a plurality of parallel rows in each of which the retorts are arranged end-to-end. The rows are separated by unbroken pillars extending upwardly from rock that is not undermined or penetrated by retorts or tunnels. The ceilings of the retorts slope upwardly at an angle of at least 40° with the horizontal to an apex or crown running longitudinally of the retorts to minimize the danger of roof collapse and provide a broadened pillar through which cross drifts opening into the crown of the retort extend for supplying combustion air. The crown of the ceiling is rounded to minimize the concentration of the forces imposed by the overburden.

54172 Combustion air supply to in-situ retorts. Kvapil, R.; Clews, K.M. (to Golder Associates, Inc.). US Patent 4,153,299. 8 May 1979. Filed date 23 May 1978. 10p.

An underground deposit of a carbonaceous material is retorted in an array of in-situ retorts arranged in a plurality of parallel rows. Each row of retorts is separated from adjacent rows by a pillar that extends unbroken for the length of the row. An apex drift extends longitudinally of each row and forms the crown of the retorts in that row. Combustion air for the retorting of the deposit in rubblized retorts in one row is supplied through the apex drift of an adjacent row. Delivery of combustion air into the crown of a retort for the retorting of the rubblized oil shale is through cross drifts from the apex drift of the adjacent row of retorts. Following combustion of the deposit in retorts in the first row, retorts are constructed and rubblized in a second row with the apex drift through which air had previously been supplied forming the crown of the retorts in the second row. Air for retorting deposit in the second row of retorts is delivered through a third apex drift.

54173 Removal of pillars from a void for explosive expansion toward the void. McCarthy, H.E.; French, G.B. (to Occidental Oil Shale, Inc.). US Patent 4,153,298. 8 May 1979. Filed date 11 Oct 1977. 18p.

A subterranean formation containing oil shale is prepared for in situ retorting by initially excavating at least one void adjacent a zone of unfragmented formation to be expanded. The zone of unfragmented formation has a substantially horizontal free face adjoining the void. At least one support pillar of unfragmented formation is left in the void for supporting overlying formation. Explosive is placed in the zone of unfragmented formation, and in such a support pillar. Explosive in such a pillar and in the zone of unfragmented formation is detonated in a single round of explosions with a time delay between detonation of explosive in such a pillar and detonation of explosive in the zone of unfragmented formation for first expanding such a pillar toward the void and then expanding unfragmented formation toward the void. The time delay is sufficient for creation of free face at the juncture of such a pillar and the zone of unfragmented formation. The time delay is preferably short enough that explosive in the zone of unfragmented formation is detonated before particles formed by explosive expansion of the pillars have come to rest on the floor of the void. The fragmented permeable mass of formation particles so formed in an in situ oil shale retort is then retorted to recover shale oil from oil shale in the fragmented mass.

54174 Ground water control for an in situ oil shale retort. Ridley, R.D. (to Occidental Oil Shale, Inc.). US Patent 4,153,297. 8 May 1979. Filed date 30 Jun 1977. 12p.

An in situ oil shale retort is formed in a subterranean formation containing oil shale. The retort contains a fragmented permeable mass of particles containing oil shale. An open base of operation is excavated in the formation above the retort site, and an access drift is excavated to the bottom of the retort site. Formation is explosively expanded to form the fragmented mass between the access drift and an elevation spaced below the bottom of the base of operation, leaving a horizontal sill pillar of unfragmented formation between the top of the fragmented mass and the bottom of the base of operation. The sill pillar provides a safe base of operation above the fragmented mass from which to control retorting operations. A plurality of blasting holes used in explosively expanding the formation extend from the base of operation, through the sill pillar, and open into the top of the fragmented mass. Trenches are formed in the base of operation for collecting ground water which enters the base of operation prior to and during retorting operations, and collected ground water is withdrawn from the base of operation. Casings can be placed in the blasting holes and adapted for controlling gas flow through the fragmented mass during retorting operations. The casings extend above the floor of the base of operation to inhibit flow of ground water through the blasting holes into the fragmented mass, and other blasting holes not having such casings are sealed. After retorting is completed, the floor of the base of operation can be covered with a layer of concrete and/or the blasting holes can be sealed with concrete to inhibit leakage of ground water into treated oil shale particles in the fragmented mass.

SURFACE METHODS

REFER ALSO TO CITATION(S) 54057

54175 Recovery of oil from oil shale. Tsai, S.C. (to Gulf Research and Development Company). US Patent 4,166,022. 28 Aug 1979. Filed date 27 Mar 1978. 6p.

A process for recovering oil from oil shale containing kerogen is described which comprises contacting said oil shale with steam having a partial pressure of at least about 600 psia (4.3 MPa) but no greater than about 3000 psia (20.8 MPa) at a reaction temperature ranging from about 300°C to about 500°C for a period of time ranging from about 0.5 to about 6 hours.

54176 Process for the preparation of synthetic crude oil. Kwant, P.B. (to Shell Oil Company). US Patent 4,165,274. 21 Aug 1979. Filed date 13 Jun 1978. 6p.

Process for treatment of tars and oil, the process being characterized by distillation of the oil to form a vacuum distillate and vacuum residue, hydrocracking of the distillate, deasphalting of the residue, and hydrodemetallizing and hydrodesulphurizing the deasphalted residue.

54177 Shale retorting process and apparatus. Dhondt, R.O. (to Union Oil Company of California). US Patent 4,162,960. 31 Jul 1979. Filed date 29 Mar 1978. 6p.

Crushed oil shale is segregated into a major portion of relatively large particles and a minor portion of fines which will pass through screen openings up to about 1/4 inch in size. The large particles are subjected to retorting as an upflowing moving bed in countercurrent contact with downflowing hot eduction gas, while the fines are retorted by controlled distribution over the hot upper surface of the bed of retorted large particles.

REFINING

REFER ALSO TO CITATION(S) 54170

54178 Process for the removal of solid particulate materials from crude shale oils. Clapper, T.W. (to Kerr-McGee Corporation). US Patent 4,162,965. 31 Jul 1979. Filed date 7 Jun 1978. 8p.

This invention relates to a process for removing finely divided insoluble particulate materials from crude shale oils. A feed comprising crude shale oil that contains insoluble particulate material is mixed with a solvent and thereafter separated in a first separation zone into a first light fraction comprising the crude shale oil and the solvent and a first heavy fraction comprising the insoluble particulate material, some crude shale oil and some dissolving solvent. The first light fraction then is withdrawn and subjected to a second separation in a second separation zone. In the second separation zone, the first light fraction is separated into a plurality of fractions of crude shale oil and solvent. The crude shale oil fractions then are separated, withdrawn and subjected to subsequent hydrorefining, while the solvent is recovered and recycled to provide additional feed mixture.

PURIFICATION

REFER ALSO TO CITATION(S) 54140

54179 Process for the production of distillate fuels from oil shales and by-product therefrom. Morrell, J.C. US Patent 4,161,441. 17 Jul 1979. Filed date 31 Oct 1977. 20p.

A continuous process for removing a substantial amount of the water present in oil shale prior to retorting the same to facilitate the rate of recovery of the oil therefrom in the retorting step of the process and to substantially increase the capacity of the latter step in the process and improve the overall efficiency thereof is described. The oil shale in subdivided form is subjected to indirect heat treatment with hot combustion gases in a partial dehydration step under relatively milder temeprature conditions than that of the retort. The vapors and gases from the partial dehydration step, in the temperature range from the prevailing temperature up to about 550°F to about 650°F, and for a sufficient time to remove substantial to major amounts of free and combined water from the oil shale accompanied by considerable amounts of oil distillate are collected. Thereafter the heated partially dehydrated oil shale is passed to the retorting step for further indirect heat treatment in the approximate range of about 850°F to about 1000°F. The vapors from the retorting step are then fractionated to remove a light overhead product comprising vapors of low boiling hydrocarbons, water, hydrocarbon gases and ammonia and wherein the heavier conversion oil products from the oil shale are condensed and separated as a liquid for further treatment and use.

PROPERTIES AND COMPOSITION

54180 (LA-UR—79-1147) **Elucidation of geomatrices by laser pyrolysis/gas chromatography and pyrolysis/mass spectrometry.** Jones, C.E.R.; Vanderborgh, N.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 22p. (CONF-790931—1). Dep. NTIS, PC A02/MF A01.

From 14. international symposium on advances in chromatography; Lausanne, Switzerland (24 Sep 1979).

Present methods for the examination of organics entrained in geological matrices ae tedious even if not fallible. Thermal degradative techniques combined with the separatory power of a gas chromatographic column or a quadrupole mass spectrometer operating low-voltage electron impact mode afford rapid access to detailed profiles of such materials. The virtue of these parallel approaches are compared and contrasted in application to the elucidation of Devonian Shale and other geological material.

54181 Pour point depressant for shale oil. Seitzer, W.H. (to Sunoco Energy Development Company). US Patent 4,166,023. 28 Aug 1979. Filed date 15 May 1978. 8p.

A process for producing a mixture of shale oils containing spherulites is described which comprises adding an effective amount of an about 1050°F plus fraction of a raw shale oil containing spherulites, e.g., prepared by a solid-upflow fluid-downflow oil shale retorting process, to a waxy shale oil not containing spherulites, e.g., prepared by a solid-downflow fluid-upflow oil shale retorting process. The formation of spherulites in the mixture is accompanied by a lowered reduction in the pour point of the resulting shale oil mixture.

DIRECT USES AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 54073

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 54010, 55618, 55623, 55624

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54073

54182 (CONF-780903—, pp 204-211) **Effects of complex effluents from in situ fossil fuel processing on aquatic biota.** Bergman, H.L.; DeGraeve, G.M.; Anderson, A.D.; Farrier, D.S. (Univ. of Wyoming, Laramie). Jul 1979.

From Symposium on potential health and environmental effects of synthetic fossil fuel technologies; Gatlinburg, TN, USA (25 Sep 1978).

In situ processes for advanced fossil fuel recovery elicit major concerns about contamination of surface and groundwater with potential effects on water uses and aquatic biota. Acute and limited-chronic toxicity bioassays were conducted to determine the effects of process waters produced from two in situ technologies being developed by DOE's Laramie Energy Technology Center: (1) Omega-9 retort water from the Rock Springs Site 9 in situ oil shale processing experiment; and (2) Hanna-3 condenser water from the Hanna underground coal gasification experiment. The acute TL_{50} dilution (50% toxicity level) for oil shale retort water was about 0.5% for rainbow trout and fathead minnows (96-h) and for Daphnia pulex (48-h), and the threshold effect dilutions for limited-chronic bioassays with rainbow trout were 0.3% for egg hatchability and 0.1% for fry growth; the principal solutes affecting the acute toxicity were probably inorganic. The acute TL_{50} dilution for underground coal gasification condenser water was about 0.1% for rainbow trout and fathead minnows (96-h) and 0.2% for Daphnia pulex (48-h), while the threshold effect dilutions for limited-chronic bioassays with fathead minnows were 0.04% for egg hatchability and 0.02% for fry growth; the principal solutes influencing acute toxicity were probably phenolics and ammonia. Possible groundwater contamination is a critical concern with in situ technologies, and studies are continuing on chemical characterization and aquatic toxicity of these process waters. 4 figures, 3 tables.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 55126

54183 (LA—7592-MS, pp 7.1-7.32) **Nuclear fuel cycle.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

The following aspects of the nuclear fuel cycle are discussed: the potential supply of uranium, uranium production-mining, UF_6 conversion, uranium enrichment; reactor fuel fabrication, nuclear reactors, reprocessing spent fuel, interim waste storage, and ultimate waste disposal.

RESERVES

54184 (GJBX—110(79)(Vol.1)) **Uraniferous phosphate resources and technology and economics of uranium recovery from phosphate resources, United States and Free World.** De Voto, R.H.; Stevens, D.N. (eds.). (Earth Sciences, Inc., Golden, CO (USA)). Jun 1979. Contract EY-76-C-13-1664. 724p. Dep. NTIS, PC A99/MF A01.

Data of the uraniferous phosphate resources of the United States are summarized in detail and of the rest of the Free World more generally. These data include all available information on the location, tonnage, and grade of the resources with respect to phosphate, uranium, and any other potential coproducts. Volume 1 comprises five chapters: introduction, summary and conclusions, uraniferous phosphate resources, United States and Free World; uraniferous resources of the southeastern United States; uraniferous phosphate resources of the western phosphate field; other uranifer-

ous phosphate resources of the United States; and uraniferous phosphate resources of the Free World exclusive of the United States. Seven appendices are included.

54185 (GJBX—110(79)(Vol.1A)) **Uraniferous phosphate resources and technology and economics of uranium recovery from phosphate resources, United States and Free World.** De Voto, R.H.; Stevens, D.N. (eds.). (Earth Sciences, Inc., Golden, CO (USA)). Jun 1979. Contract EY-76-C-13-1664. 252p. Dep. NTIS, PC A12/MF A01.

Volume 1A contains the plates for chapters 2 and 3, uraniferous phosphate resources, United States and Free World.

54186 (GJBX—110(79)(Vol.2)) **Uraniferous phosphate resources and technology and economics of uranium recovery from phosphate resources, United States and Free World.** De Voto, R.H.; Stevens, D.N. (eds.). (Earth Sciences, Inc., Golden, CO (USA)). Jun 1979. Contract EY-76-C-13-1664. 672p. Dep. NTIS, PC A99/MF A01.

The technical, economic, and environmental feasibility of production of uranium as a by-product, coproduct, or single product from the uraniferous phosphate resources is evaluated. Volume 2 comprises seven chapters: introduction, summary and conclusions, technology and economics of uranium recovery from phosphate resources, United States and Free World; phosphate mining and beneficiation; wet-process phosphoric acid production; uranium recovery from wet-process phosphoric acid; uranium recoverable from phosphoric acid, United States and Free World, 1978 to 2025; single and coproduct uranium recovery from phosphate resources; and research and development. Seven appendices are included.

54187 (GJBX—130(79)) **Investigation of the relationship between organic matter and uranium deposits.** Schmidt-Collerus, J.J. (Denver Research Inst., CO (USA)). Jun 1978. Contract EY-76-C-13-1664. 295p. Dep. NTIS, PC A13/MF A01.

Topical literature and the initial results of investigations on the relationship between organic matter and uranium ore formation are summarized. Primary emphasis is focused on the investigation of humic and fulvic acids and their uranium complexes as they occur in uraniferous peat deposits. Extraction and separation of humic and fulvic acids are presented and the initial results of fractionation of these materials by gel permeation and other methods are described. The potential relationship between organic matter and uranium is discussed and a working theory developed. Based on this theory the experimental research program was initiated. The experimental results obtained to date are encouraging and indicate the significant role of fulvic and humic acids in the formation of economic secondary uranium ore deposits.

EXPLORATION

54188 (GJBX—104(79)(Vol.2)) **Aerial radiometric and magnetic survey: Tonopah National Topographic Map, Nevada.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 91p. Dep. NTIS, PC A05/MF A01.

Volume 2 contains the flight line profile data and statistical analysis results from the aerial radiometric and magnetic survey of the Tonopah National Topographic Map area of Nevada.

54189 (GJBX—107(79)(Vol.2)) **Aerial radiometric and magnetic survey: Dillon National Topographic Map, Montana.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 74p. Dep. NTIS, PC A04/MF A01.

The flight line profile data and statistical analysis results from the aerial radiometric and magnetic survey of the Dillon National Topographic Map area of Montana are presented.

54190 (GJBX—114(79)(Vol.2)) **Aerial radiometric and magnetic survey: Needles National Topographic Map, California and Nevada.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 202p. Dep. NTIS, PC A10/MF A01.

Flight line profile data and statistical analysis results from the aerial radiometric and magnetic survey of the Needles National Topographic Map area in California and Nevada are presented.

54191 (GJBX—117(79)(Vol.2)) **Aerial radiometric and magnetic survey: Price National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 160p. Dep. NTIS, PC A08/MF A01.

Volume 2 contains flight line profile data and statistical analysis results from the aerial radiometric and magnetic survey of the Price National Topographic Map area of Utah.

54192 (GJBX—118(79)(Vol.2)) **Aerial radiometric and magnetic survey: Tooele National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 151p. Dep. NTIS, PC A08/MF A01.

Flight line profile data and statistical analysis results from the aerial radiometric and magnetic survey of the Tooele National Topographic Map area of Utah are presented.

54193 (GJBX—127(79)) **Engineering report on the drilling in the Missoula/Bitterroot Basins of Montana.** (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Aug 1979. Contract EY-76-C-13-1664. 36p. Dep. NTIS, PC E03/MF E03.

This report presents engineering details, statistics, individual borehole histories and geophysical logs of the seven holes drilled in the Missoula/Bitterroot Drilling Program. Objective was to obtain data which could enable more accurate assessments to be made of the favorability for uranium in the predominantly unexplored subsurface of the Missoula/Bitterroot Tertiary basins. This project started on May 9, 1978, and continued until January 9, 1979, when it was temporarily discontinued due to severe weather conditions and serious mechanical problems with the drilling rig. The remaining hole was completed between March 23, 1979, and April 6, 1979.

FEED PROCESSING

REFER ALSO TO CITATION(S) 54184, 54185, 54186

ENRICHMENT

54194 (ORNL/TM—6812) **Survey of knowledge of hazards of chemicals potentially associated with the advanced isotope separation processes.** Chester, R.O.; Kirkscey, K.A.; Randolph, M.L. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 82p. Dep. NTIS, PC A05/MF A01.

Hazards of chemical potentially associated with the advanced isotope separation processes are estimated based on open literature references. The tentative quantity of each chemical associated with the processes and the toxicity of the chemical are used to estimate this hazard. The chemicals thus estimated to be the most potentially hazardous to health are fluorine, nitric acid, uranium metal, uranium hexafluoride, and uranium dust. The estimated next most hazardous chemicals are bromine, hydrobromic acid, hydrochloric acid, and hydrofluoric acid. For each of these chemicals and for a number of other process-associated chemicals the following information is presented: (1) any applicable standards, recommended standards and their basis; (2) a brief discussion to toxic effects including short exposure tolerance, atmospheric concentration immediately hazardous to life, evaluation of exposures, recommended control procedures, chemical properties, and a list of any toxicology reviews; and (3) recommendations for future research.

GASEOUS DIFFUSION

REFER ALSO TO CITATION(S) 54639

LASER EXCITATION

REFER ALSO TO CITATION(S) 55387, 55389

54195 **Uranium isotope separation and its demand on laser development.** Rockwood, S. (Los Alamos Scientific Lab., NM). pp 140-149 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

The spectroscopic prerequisites for performing isotopically selective excitation of UF_6 are reviewed. These data have been obtained and the emphasis is now turned towards developing the lasers to perform the work.

FUELS PRODUCTION AND PROPERTIES

54196 (HEDL-TME—79-16) **Glovebox glove deterioration in the Hanford Engineering Development Laboratory fuel fabrication facility.** Greenhalgh, W.O.; Smith, R.C.; Powell, D.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 44p. Dep. NTIS, PC A03/MF A01.

Neoprene glovebox gloves have been found susceptible to periodic rapid deterioration under normal operating conditions in fuel fabrication facilities. Examinations of glove failure histories and measurements of the atmospheres in inert atmosphere dry-boxes indicated ozone at low concentrations of 100 to 500 ppB was probably the most important factor in rapid glove deterioration. Testing of a varity of new glove materials indicated that Hypalon and ethylene-propylene-diamine monomer (EDPM) gloves have greater than 30 times the longevity of neoprene in low-level ozone concentration atmospheres. comparative tests over a 30-month

period have also confirmed that the two glove candidates have a significantly longer operative life. 14 figures.

54197 (INIS-mf—4903, pp 123-133) **Kinetics of bubble formation in fissile materials.** Mikhlin, Eh.Ya.; Chkuaseli, V.F. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The model enabled the kinetics of bubble formation in fissile and some other materials to be described where irradiation induced nuclear reactions result in a solid solution supersaturated with inert gases has been developed. The conclusion has been drawn that the mechanism of coalescence of random walking bubbles is a principal one for bubble formation observed both on and outside of dislocations.

54198 (INIS-mf—4905, pp 277-286) **Release of gaseous fission products during plastic deformation of polycrystalline ceramic fuel under irradiation.** Naboichenko, K.V.; Elesin, V.F.; Zolotukha, Yu.S.; Minaev, E.M. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The paper is concerned with the theoretical model which descibes release of gaseous fission products during plastic deformation of a polycrystalline fissioning sample under irradiation. The model considers a polycrystalline structure of the sample and takes account of the fact that gas is released out of the grains being in mutual contact and, thus, their external surfaces have extension and compressive regions. The analytical solution of a nonstationary equation of the diffusion-convective transfer has been obtained for a half-plane; the equation has been used to describe the experimental results on Kr^{88} and Xe^{138} release from uranium dioxide. Calculations are found to be in satisfactory agreement with the experimental data.

54199 (INIS-mf—4905, pp 252-276) **Structural changes and behaviour of gaseous fission products in UO_2 under irradiation.** Samsonov, B.V. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The fundamentals of a noncontradictory phenomenological theory that explains gas fission products behaviour in uranium dioxide under irradiation are given. A mathematical model is proposed for estimating gas release from uranium dioxide and changes in the fuel volume. It is found that the process of void formation in the fuel under irradiation differs greatly from that in the post-irradiated fuel samples. It is shown that experimental and calculated data on changes in Uranium dioxide volume are in a good agreement in temperature range of 1300 to 2000 K.

54200 (WCAP—9468) **Research and development program for selected components of mixed oxide fuel fabrication. Quarterly progress report, period ending December 31, 1978.** Limpert, J.C. (comp.). (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). 1978. Contract EN-77-C-06-1058-001. 119p. Dep. NTIS, PC A06/MF A01.

This quarterly report is the seventh of a series of reports on research and development projects for selected components of mixed oxide (MOX) fuel fabrication in support of the light water reactor (LWR) fuel cycle. This program originally consisted of seven MOX fuel fabrication tasks supporting both of DOE's major near-term objectives: the conceptual design of proliferation-resistant fuel refabrication facilities, and the development of improved fuel cycle technology. Four of the seven original tasks have been completed to date - task 1, Advanced Accountability Systems Development; task 4, Planning Related to the Conceptual Design of Large-Scale MOX Fabrication Facilities; task 5, Residual Material Holdup and Powder Release; and task 7, Waste Management. Currently being performed are three of the original tasks - task 2, Pneumatic Powder Transport System Development; task 3, Powder Batch Weighing System Development; and task 6, Barrier Seal Development - and two supplementary tasks - task 201, Remote MOX Fabrication Facility Development; and task 202, Waste Management Study. Technical progress on these active tasks is the subject of this report.

54201 (WCAP—9490) **Assessment of pneumatic powder transfer for use in fuels refabrication plants.** Lyon, W.L.; Larouere, P.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Div.). Mar 1979. Contract EN-77-C-06-1058-002. 40p. Dep. NTIS, PC A03/MF A01.

As part of the overall Fuels Refabrication and Development (FRAD) Program being conducted for the US DOE, Westinghouse has completed a task whose objective was to perform an evaluation of the pneumatic transport of nuclear fuel powders. The task included the installation and testing of representative segments of a full scale pneumatic transport system. This report provides conclusions and recommendations based on the results of the test program as well as an assessment of the advantages and disadvantages of the use of pneumatic transport for conveying powders within a commercial mixed oxide fuels refabrication facility. Criteria for the design and operation of systems for the pneumatic transport of mixed oxide powders in commercial mixed oxide fuel fabrication facilities are recommended. One possible disadvantage is the requirement for blowback filters.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 54215, 55318, 55319

54202 (CONF-791103—24) **Dissolution process for advanced-PWR-type fuels.** Black, D.E.; Decker, L.A.; Pearson, L.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 2p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The new Fluorinel Dissolution Process and Fuel Storage (FAST) Facility at ICPP will provide underwater storage of spent PWR fuel and a new head-end process for fuel dissolution. The dissolution will be two-stage, using HF and HNO_3, with an intermittent H_2SO_4 dissolution for removing stainless steel components. Equipment operation is described. (DLC)

54203 (GA-A—15374) **Continuous solvent extraction feed preparation in thorium fuel reprocessing.** Wilbourn, R.G.; Olguin, L.J. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-053. 27p. (CONF-790602—85). Dep. NTIS, PC A03/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Bench- and pilot-scale test results show that the continuous preparation of solvent extraction feed solutions is feasible for first-cycle and second-cycle thorium fuel process operations. The continuous-feed preparation mode provides a direct interface between dissolution and solvent extraction operations.

54204 (GA-A—15447) **HTGR fuel particle crusher: Mark 2 design.** Baer, J.W. (General Atomic Co., San Diego, CA (USA)). Jun 1979. Contract AT03-76SF71053. 47p. Dep. NTIS, PC A03/MF A01.

The double-roll crusher for fracturing the silicon carbide coatings of high-temperature gas-cooled reactor (HTGR) fuel particles has been redesigned to improve the equipment. The housing was simplified and reduced to a two-piece assembly; the bearings were changed to accommodate thermal effects; the bearing protection seals were improved with triple redundancy; the bearing preload arrangement was simplified and improved; and localized wear areas were reinforced with better materials or special treatment. In addition, the crusher drive was changed for impoved characteristics and an increase in power.

54205 (GA-A—15452) **Consolidated fuel recycle program. Annular pulse column development studies interim development report.** Benedict, G.E. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-053. 29p. Dep. NTIS, PC A03/MF A01.

The capacity of critically safe cylindrical pulse columns limits the size of nuclear fuel solvent extraction plants because of the limited cross-sectional area of plutonium, U-235, or U-233 processing columns. Thus, there is a need to increase the cross-sectional area of these columns. This can be accomplished through the use of a column having an annular cross section. The preliminary testing of a pilot-plant-scale annular column has been completed and is reported. The column is made from 152.4-mm (6-in.) glass pipe sections with an 89-mm (3.5-in.) OD internal tube, giving an annular width of 32 mm (1.25 in.). Louver plates are used to swirl the column contents to prevent channeling of the phases. The data from this testing indicate that this approach can successfully provide larger-cross-section critically safe pulse columns. While the capacity is only 70% of that of a cylindrical column of similar cross section, the efficiency is almost identical to that of a cylindrical column. No evidence was seen of any nonuniform pulsing action from one side of the column to the other. 6 figures, 5 tables.

54206 **Reprocessing in Germany.** Salander, C. pp 260-265 of Uranium supply and demand. Spriggs, M.J.; Casteel, K.D. (eds.). London; Mining Journal Books (1978).

From 3. international symposium on uranium supply and demand; London, UK (12 Jul 1978).

A brief account is presented of the opposition to the construction of fuel reprocessing plants in the Federal Republic of Germany. The nuclear fuel cycle and the waste treatment centre are shown in diagrams. Licensing procedures and information campaigns are described. The urgent need to find solutions to present problems is stressed.

54207 (INIS-mf—4691, pp 75-106) **Project reprocessing and waste treatment (PWA).** 1978. (In German).

In Progress report on research and development in 1977. Under the heading 'reprocessing and waste treatment', the annual report of the reprocessing and waste treatment project 'PWA' describes the projects carried out by the participating institutes.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 54229, 54249, 55374

54208 (CAEC—012) **Assessment of the long-term storage of zircaloy fuel rods in water.** Munir, Z.A. (California Univ., Davis (USA). Dept. of Mechanical Engineering). 15 Oct 1977. 28p. NTIS, PC A02/MF A01.

This report is a preliminary assessment of corrosion mechanisms which might affect the integrity of zircaloy-clad fuel rods during long periods of underwater storage. Potential corrosion mechanisms are discussed, and those which merit further investigation are identified. These are the principal recommendations. Current methods of degradation assessment of spent fuel are inadequate; other methods must also be used. The general corrosion of zircaloy under water storage is believed to be too low to justify concern over periods of 10 to 20 years. Additional experimental work is needed to establish the roles of the following variables on zircaloy corrosion: degree of residual stress; fission product uptake and the degree of prior embrittlement; galvanic coupling with other metals of the fuel rod storage assembly; and the nature and concentrations of surface layer contaminants accumulated during reactor residence.

54209 (INIS-mf—4639, pp vp) **Seismic analysis of spent fuel racks.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54210 (INIS-mf—4685) **Intermediate spent fuel storage at Ahaus. Short description. June 1978.** (Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen m.b.H. (DWK), Hannover (Germany, F.R.); STEAG Kernenergie G.m.b.H., Essen (Germany, F.R.)). 1978. 112p. (In German). Dep. NTIS (US Sales Only), PC A07/MF A01.

This short description discusses in popular form: The necessity of the plant (capacity = 1500 t U), licensing procedure, site, environmental effects, operation, effects and countermeasures of accidents (safety analysis), and decommissioning.

MARKETING AND ECONOMICS

54211 (DOE/RA—0038) **Survey of United States uranium marketing activity.** (Department of Energy, Washington, DC (USA). Office of Uranium Resources and Enrichment). Aug 1979. 33p. Dep. NTIS, PC A03/MF A01.

Results from a survey of US uranium marketing and procurement in 1978 are presented. Information for the present survey was received from 61 utilities with nuclear reactor projects, 35 present or potential uranium producers, and 5 reactor manufacturers. The survey requested data on domestic uranium purchase commitments, uranium imports and exports, unfilled requirements, U_3O_8 available for sale by producers, inventories of domestic- and foreign-origin uranium, inventory policies, and prices under existing contracts between domestic primary producers and domestic buyers. Information on actual and planned capital expenditures for uranium production facilities, also gathered in the survey, will be presented in a separate report.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54071, 55051

54212 (CAEC—007) **Low-level radioactive waste management. Volume 1. Current power reactor low-level radwaste.** Feigollaki, F.; Connelly, J.M.; Jentz, T.L. (NUS Corp., Rockville, MD (USA)). Mar 1978. 271p. Nuclear Services Corporation, 1700 Dell Avenue, Campbell, CA.

This volume contains basic information and background data on current industry practices in the area of power reactor low-level-waste management in the USA and in California in particular. Radwaste characterization, waste sources other than LWR plants, packaging and transportation criteria, disposal criteria, burial sites, related activities, costs, etc. are discussed. (DLC)

54213 (CONF-791103—17) **Strategy analysis for krypton-85 waste management.** Knecht, D.A.; Brown, R.A. (Allied Chemical Corp., Idaho Falls, ID (USA)). 1979. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Krypton-85 is a chemically inert, radioactive gas produced by fission of uranium or plutonium isotopes. Depending on the fuel cycle, krypton-85 production in nuclear reactors may range from ~ 200 to ~ 600 kCi/GW/sub e/-year. However, the EPA has published a standard restricting krypton-85 release to 50 kCi/GW/sub e/-year for fuel irradiated after January 1, 1983. To conform with the federal standard, recovery and storage of krypton-85 will be required in some nuclear fuel cycle processes. The long-term waste management of krypton-85 poses unique judgemental problems. Release, recovery, immobilization, and storage (individually, and in combinations), involve a wide range of environmental, economic, and social commitments. The choice of applicable technologies, if such technologies are to be used at all, imposes another set of boundary conditions. This strategy analysis describes the use of a general framework for decision-making in evaluating krypton-85 waste management systems. Such a framework can be further used to provide technical assessment and dose-probability calculations for individual technologies, and to show the interactions among technological options required for the overall waste management scheme.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 54207, 54682

54214 (RHO-SA—110) **Modification of ion chromatograph for analyses of radioactive samples.** Curfman, L.L.; Johnson, S.J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1979. Contract EY-77-C-06-1030. 13p. (CONF-790666—4). Dep. NTIS, PC A02/MF A01.

From 34. Northwest regional meeting of the American Chemical Society; Richland, WA, USA (13 Jun 1979).

In ion chromatographic analysis, the sample is injected through a sample loop onto an analytical column where separation occurs. The sample then passes through a suppressor column to remove or neutralize background ions. A flow-through conductivity cell is used as a detector. Depending upon column and eluent selection, ion chromatography can be used for anion or cation analyses. Ion chromatography has proven to be a versatile analytical tool for the analysis of anions in Hanford waste samples. These radioactive samples range from caustic high salt solutions to hydrochloric acid dissolutions of insoluble sludges. Instrument modifications which provide safe and convenient handling of these samples without lengthening analysis time or altering instrument performance are described.

54215 (RHO-CD—456) **Preliminary laboratory investigation for the removal of radioactive cesium from Purex aqueous waste solutions.** Murphy, P.P.; Buckingham, J.S. (Northwest Organization for College and University Science; Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). [nd]. Contract EY-77-C-06-1030. 19p. Dep. NTIS, PC A02/MF A01.

The laboratory work reported in this paper showed that cesium can be removed from current acid waste (CAW) by first removing strontium and rare earth by solvent extraction then passing the resulting 1AW solution through an ion exchange column containing a zeolite. The method for removing strontium and rare earth by solvent extraction is well documented and is not discussed here. Zeolon-900, a synthetic zeolite made by Norton Company, had the highest affinity for cesium of the ion exchangers tested. Maximum cesium absorption occurred between pH 4.0 and pH 8.5. The absorption of cesium from CAW or 1AF was lower than that observed with 1AW. 1AF is B Plant solvent extraction feed made from CAW. 1AW is waste raffinate from solvent extraction. Laboratory ion exchange column runs showed five percent cesium breakthrough occurred at 92 column volumes. Decontamination factors of 1.17×10^4 and 2.92×10^3 were found for aluminum and iron, respectively, during a laboratory column run. Sodium decontamination factors were not measured for these runs; however, Nelson, Alkaire, and Mercer found the decontamination of sodium from cesium during the processing of acid wastes was 1×10^4.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 54208, 54209, 54241, 55061, 55638, 55639

54216 (COO—4917-1) **Legal, political, and institutional implications of the sea-bed program for radioactive waste disposal. Annual technical progress report.** Doty, P. (Harvard Univ., Cambridge, MA (USA). Center for Science and International Affairs). 19 Apr 1979. Contract EW-78-S-02-4917. 5p. Dep. NTIS, PC A02/MF A01.

Both domestic and international political feasibility studies are being conducted for sub-seabed disposal. (DLC)

54217 (INIS-mf—4691, pp 107-112) **Underground storage (TLA).** 1978. (In German).

In Progress report on research and development in 1977.

The underground storage project (TLA) describes the activities of the department for the treatment of radioactive waste (ABRA) under the aspect of final storage technology and safety.

54218 (INIS-mf—4915) **Situation on regulatory aspects of underground disposal of radioactivity wastes in Japan.** Murano, T.; Asano, T.; Matsubara, N. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 5p. Dep. NTIS (US Sales Only), PC A70/MF A01.

At present, in Japan, there exists no law specifically regulating the underground disposal of radioactive wastes although various regulations deal with disposal safety measures in a general way. For the moment, apart from the need to gain public acceptance of such disposal, the problem is essentially one of technical feasibility, and a geological study is currently being undertaken by the Science and Technology Agency. This same Agency is also looking at the problem of a long-term waste management system, but it is the Nuclear Safety Commission, created in 1978, which will be primarily responsible for all regulatory aspects of safety.

54219 (INIS-mf—4916) **Regulation of radioactive waste management in Canada.** (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1978. 22p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Radioactive waste management facilities are subject to the Atomic Energy Control Regulations under jurisdiction of the Atomic Energy Control Board. Before such a facility can be constructed and permitted to operate, the applicant must obtain from the AECB in turn, site approval, a construction approval, and an operating licence, different considerations (e.g. geological, security) being given priority at each stage. Operating licences are normally valid for one year only, their renewal being dependent on observance, by the applicant, of the procedures and conditions laid down by the Board. Licensing document No.23 offers guidance on the requirements involved both generally and in relation to specific methods of waste storage and disposal. A copy of this document is attached to the present paper.

54220 (INIS-mf—4917) **Regulating underground disposal of radioactive waste in the United States.** (National Research Council, Washington, DC (USA)). 1978. 13p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In the United States, a number of Federal agencies have regulatory, research or operational responsibilities in the area of nuclear waste management. In particular, the Department of Energy (DOE) is engaged in the treating and disposal of radioactive waste, while under various federal laws, the Nuclear Regulatory Commission (NRC) has wide responsibilities in this field. High-level waste on the one hand, and low-level waste on the other, are being studied under the current NRC research programme aimed at establishing appropriate standards and regulations to be applied in the management of radioactive waste.

54221 (INIS-mf—4919) **Underground disposal of radioactive waste regulations in The Netherlands.** Cornelis, J.C. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The only method of final disposal of radioactive waste currently envisaged in the Netherlands is disposal in rock-salt. This question is at present being studied by governmental authorities, and a public discussion is foreseen for the near future. Various Ministries, as well as local authorities at both provincial and municipal levels, are involved in the licensing and control of waste disposal. The principal stages are site selection (including that for test-drilling), construction of the mine, and supervision of the repository. These activities are governed by the legislation on mining as well as by nuclear regulations. One matter still to be decided is the nature of the body to be responsible for conducting the disposal operations.

54222 (INIS-mf—4922) **General and regulatory aspects of nuclear waste disposal in Finland.** Vaeisaenen, S. (Institute of Radiation Protection, Helsinki (Finland)). 1978. 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The Minister of Trade and Industry has recently appointed a committee to review the legislation in the nuclear energy field. The mandate of the committee includes the formulation of a law on nuclear waste management, which problem is also the subject of a current research and development programme. Licensing and control measures for nuclear installations already exist and these do include general safety measures relating to the management of nuclear waste. There are three types of licence - construction licence (including site approval), operating licence and fuel licence - given by the Ministry of Trade and Industry after consultation with various bodies, notably, the Institute of Radiation Protection. Conditions may be imposed on granting a licence, and periodic inspections are carried out during the operation of the installation. This licensing procedure, modified when necessary, could be applied to waste disposal facilities.

54223 (INIS-mf—4923) **Legislative provisions governing installations for the disposal of radioactive waste in Spain.** (Junta de Energia Nuclear, Madrid (Spain)). 1978. 5p. (In Spanish). Dep. NTIS (US Sales Only), PC A02/MF A01.

Together with the other installations defined as nuclear or radioactive in the Law on Nuclear Energy of 1964, the construction and operation of nuclear waste facilities are subject to the prior authorisation of the Minister of Industry and Energy. They are also subject to the regulations applicable to mining activities. However, for the moment there exist no criteria regulating the underground disposal of radioactive waste, although it is generally agreed that responsibility for such disposal should be given to a public body, for instance the Junta de Energia Nuclear. Moreover, it is this body which is in charge of the sole existing installation in Spain for the storage of solid radioactive waste. (NEA) .

54224 (INIS-mf—4924) **Regulatory aspects on underground disposal of radioactive waste in Sweden.** Larsson, A. (Statens Kaernkraftinspektion, Stockholm (Sweden)). 1978. 2p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The underground disposal of radioactive waste in Sweden is primarily governed by the Atomic Energy Act, the Radiation Protection Act, and to some extent by the Nuclear Liability Act. The regulatory authorities in question are the Nuclear Power Inspectorate, and the Radiation protection Institute. Application for a licence relating to waste management facilities are examined by the Inspectorate which presents its recommendations to the Government for decision. The Inspectorate is also called upon to impose conditions for the operation of the installation. The choice of site for the proposed nuclear waste facility is subject to the approval of the local authorities concerned.

54225 (INIS-mf—4925) **Regulatory aspects of underground disposal of radioactive waste in Switzerland.** Luethi, H.R. (Eidgenoessisches Amt fuer Energiewirtschaft, Bern (Switzerland)). 1978. 8p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The management of radioactive waste has become an important problem in Switzerland, and work has now begun on technical investigations and the preparation of a regulatory framework for deep-underground disposal. The law currently in force is the Federal Law on the Peaceful Use of Atomic Energyy and Radiation Protection, under which two licences are required, one for construction and one for operation. An amendment to this Law is envisaged whereby the licensing system will be modified, in particular by requiring an additional licence which will be granted by the Federal Government, with the consent of Parliament, if the safe disposal of waste can be guaranteed. The producers of radioactive waste are primarily responsible for the management thereof, but the National Co-operative Society for the Storage of Radioactive Waste (NAGRA) has the task of planning, constructing and operating repositories. The licensing authority in Switzerland is the Federal department of Communications and Energy.

54226 (INIS-mf—4926) **Regulatory aspects of underground disposal of radioactive waste in the United Kingdom.** (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

It is a basic principle of radioactive waste management in the U.K. to comply with the system of dose limitations laid down by the International Commission on Radiological Protection. The Radioactive Substances Act, 1960, prohibits the disposal of radioactive waste on or from all premises (except those belonging to the Crown) unless authorised by the appropriate authority. Consultation, as necessary, with local and public authorities is provided for. Under the Nuclear Installations Act, 1965, nuclear installations, with some exceptions, require to be licensed by the Health and safety executive. Installations for the disposal of radioactive waste are not, as such, prescribed as nuclear installations under the Nuclear Installations Act, 1965 (and thereby governed by the licensing procedure under the Act), but they may be, if they involve the storage of bulk quantities of radioactive waste. The Secretary of State for the Environment, together with the Secretaries of State for Scotland and Wales are responsible for the development of a nuclear waste management policy, helped in this task by the newly-formed Radioactive Waste Management Advisory Committee.

54227 (INIS-mf—4927) **Situation on regulatory aspects of underground disposal of radioactive waste in Austria.** Muhlberger, F. (Bundesministerium fuer Gesundheit und Umweltschutz, Vienna (Austria)). 1978. 2p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In Austria, under the Law on Radiation Protection, 1969, the construction and the operation of radioactive waste facilities both require to be licensed. Applications must be accompanied by detailed documentation and a licence will be granted only if safety is guaran-

teed and evidence given that any conditions imposed by the licensing authority have been, or will be, respected. Provision is also made for the later inspection of the facility. Additional licences, for example, under legislation relating to construction, or water, are also required.

54228 (LA—7918-PR) **Potential microbial impact on transuranic wastes under conditions expected in the Waste Isolation Pilot Plant (WIPP). Progress report, March 15-June 15, 1979.** Barnhart, B.J.; Campbell, E.W.; Martinez, E.; Caldwell, D.E.; Hallett, R. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

The chelate Desferol, which is representative of microbially produced polyhydroxamate chelates, greatly enhances the dissolution of plutonium from insoluble $^{239}PuO_2$. Radiobiological studies showed that bacterial isolates from LASL transuranic burial site soil exhibit levels of radioresistance intermediate to that of B. subtilis and M. radiodurans. Also included in this report are the first tables of data from the CO_2 gas generation studies with the corresponding modeling equations derived from the linear regression statistical analysis procedure. The data for the chelate degradation studies are updated and include data for EDTA chelate. Results of the experiment to enumerate and identify the microorganisms in the salt beds of the WIPP facility are reported as negative, as no microbial growth was detected from three salt samples. 9 tables.

54229 (RHO-C—25(Vol.1)(Draft)) **Dry Well Storage Facility conceptual design study.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Kaiser Engineers, Oakland, CA (USA)). Feb 1979. Contract EY-77-C-06-1030;EY-76-C-06-2195. 158p. Dep. NTIS, PC A08/MF A01.

The Dry Well Storage Facility described is assumed to be located adjacent to or near a Spent Fuel Receiving and Packaging Facility and/or a Packaged Fuel Transfer Facility. Performance requirements, quality levels and codes and standards, schedule and methods of performance, special requirements, quality assurance program, and cost estimate are discussed. Appendices on major mechanical equipment and electric power requirements are included.

54230 (SAND—79-0280) **Basic data report for drillhole WIPP 26 (Waste Isolation Pilot Plant - WIPP).** (Sandia Labs., Albuquerque, NM (USA); Geological Survey, Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 92p. Dep. NTIS, PC A05/MF A01.

WIPP 26 was drilled in Nash Draw (SE 1/4 NE 1/4, sec. 29, T22S, R30E) in Eddy County, New Mexico, to determine subsurface stratigraphy and examine dissolution features above undisturbed salt in the Salado Formation. Determination of dissolution rates will refine previous estimates and provide short-term (geologically) rates for WIPP risk assessments. The borehole encountered, from top to bottom, surficial deposits (10 ft with full materials for pad), Rustler Formation (299 ft), and the upper 194 ft of the Salado Formation. A dissolution residue, 11 ft thick, is at the top of the Salado Formation overlying halite-rich beds. In addition to obtaining nearly continuous core from the surface to total depth (503 ft), geophysical logs were taken to measure acoustic velocities, density, radioactivity, and formation resistivity. An interpretive report on dissolution in Nash Draw will be based on combined borehole basin data, surface mapping, and laboratory analyses of Nash Draw rocks and fluids. The WIPP is to demonstrate (through limited operations) disposal technology for transuranic defense wastes and to then be converted to a repository. The WIPP will also provide research facilities for interactions between high-level waste and salt.

54231 (SAND—79-0282) **Basic data report for Drillhole WIPP 28 (Waste Isolation Pilot Plant - WIPP).** (Sandia Labs., Albuquerque, NM (USA); Geological Survey, Denver, CO (USA)). Aug 1979. Contract EY-76-C-04-0789. 118p. Dep. NTIS, PC A06/MF A01.

WIPP 28 was drilled in Nash Draw (NE 1/4, sec. 18, T.21S., R.31E.) in Eddy County, New Mexico, to determine subsurface stratigraphy and examine dissolution features above undisturbed salt in the Salado Formation. Determination of dissolution rates will refine previous estimates and provide short-term (geologically) rates for WIPP risk assessments. The borehole encountered, from top to bottom, Mescalero caliche (12 ft with fill material for pad), Dewey Lake Red Beds (203 ft), Rustler Formation (316 ft), and the upper 270 ft of the Salado Formation. A dissolution residue, 58 ft thick, is at the top of the Salado Formation overlying halite-rich beds. In addition to obtaining nearly continuous core from the surface to total depth (801 ft), geophysical logs were taken to measure acoustic velocities, density, radioactivity, and formation resistivity. An interpretive report on dissolution in Nash Draw will be based on combined borehole basin data, surface mapping, and laboratory analyses of Nash Draw rocks and fluids. The WIPP is to demonstrate (through limited operations) disposal technology for transuranic defense wastes and to then be converted to a repository. The WIPP will also provide research facilities for interactions between high-level waste and salt.

54232 (SAND—79-0640) **Waste isolation pilot plant (WIPP) borehole plugging program description.** Christensen, C.L.; Hunter, T.O. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789;EY-76-C-06-1830. 63p. Dep. NTIS, PC A04/MF A01.

The tests and experiments described attempt to provide a mix of borehole (with limited access) and in-mine (with relatively unlimited access) environments in which assessment of the various issues involved can be undertaken. The Bell Canyon Test provides the opportunity to instrument and analyze a plug in a high pressure region. The Shallow Hole Test permits application of best techniques for plugging and then access to both the top and bottom of the plug for further analysis. The Diagnostic Test Hole permits recovery of bench scale size samples for analysis and establishes an in-borehole laboratory in which to conduct testing and analysis in all strata from the surface into the salt horizon. The additional in mine experiments provide the opportunity to investigate in more detail specific effects on plugs in the salt region and allows evaluation of instrumentation systems.

54233 (SAND—79-1210C) **Retrieval methods and equipment for WIPP high-level waste experiment area.** Dennis, A.W.; Stinebaugh, R.E. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 7p. (CONF-791103—10(Summ.)). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The method and equipment required to conduct full-scale in-situ high-level waste experiment in a geologic repository are being developed at Sandia Laboratories. A brief description of the retrieval task and the equipment being developed to perform this task is presented and is shown to be within the existing state-of-the-art.

54234 (SAND—79-1430C) **Thermal/fluid modeling of the response of saturated marine red clays to emplacement of nuclear waste.** McVey, D.F.; Gartling, D.K.; Russo, A.J. (Sandia Labs., Albuquerque, NM (USA)). 1979. EY-76-C-04-0789. 22p. (CONF-790938—2). Dep. NTIS, PC A02/MF A01.

From Workshop on the use of argillaceous materials for the isolation of radioactive wastes; Paris, France (10 Sep 1979).

This report discusses the heat and mass transport in marine red clay sediments being considered as a nuclear waste isolation medium. Development of two computer codes, one to determine temperature and convective velocity fields, the other to analyze the nuclide migration problem, is discussed and preliminary results from the codes reviewed. The calculations indicate that for a maximum allowable sediment/canister temperature range of 200 to 250°C, the sediment can absorb about 1.5 kW initial power from waste in a 3 m long by 0.3 m diameter canister. The resulting fluid displacement due to convection is found to be small, less than 1 m. The migration of four nuclides, ^{239}Pu, ^{137}Cs, ^{129}I, and ^{99}Tc were computed for a canister buried 30 m deep in 60 m thick sediment. It was found that the ^{239}Pu and ^{137}Cs, which migrate as cations and have relatively high distribution coefficients, are essentially completely contained in the sediment. The anionic species, ^{129}I and ^{99}Tc, which have relatively low distribution coefficients, broke through the sediment in about 5000 years. The resultant peak injection rates which occur at about 15,000 years were extremely small (0.5 μCi/year for ^{129}I and 180 μCi/year for ^{99}Tc).

54235 (SAND—79-1475C) **Thermal and chemical properties of saturated marine clays in a near field environment.** Krumhansl, J.L.; Hadley, G.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 13p. (CONF-790938—1). Dep. NTIS, PC A02/MF A01.

From Workshop on the use of argillaceous materials for the isolation of radioactive wastes; Paris, France (10 Sep 1979).

Thermal and geochemical investigations were made on water saturated marine clays for the purpose of determining whether such sediments would have properties favorable for the disposal of high level waste. Thermal conductivity and diffusivity were found to remain relatively constant between 25 and 300°C. The chemistry of seawater-sediment mixtures, however, undergoes marked changes with heating. A distinctly acidic condition may be generated above 200°C and many trace elements are solubilized. Mineralogic changes are dominated by the formation of a magnesium-rich smectite clay. These changes are, however, of sufficiently localized extent that a considerable barrier to radionuclide migration would remain between an emplaced waste canister and the ocean floor.

54236 (TREE—1321) **Early waste retrieval. Final report.** Bishoff, J.R.; Hudson, R.J. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 33p. Dep. NTIS, PC A03/MF A01.

The Early Waste Retrieval Project began operations in FY 1976 to investigate methods, risks, and hazards associated with the retrieval of 65,000 m^3 of transuranic contaminated waste in below grade storage. The retrieval facilities consisted of an Air Support Weather Shield and a movable Operating Area Confinement. Re-

trieval operations were conducted in the Operating Area Confinement to prevent contamination spread to the environment. The Air Support Weather Shield provided weather protection for the Operating Area Confinement and all associated retrieval equipment. Retrieval personnel wore full anticontamination clothing and a totally enclosed bubble suit that incorporated a fresh air supply. Waste retrieved included drums, loose waste, and contaminated soil. Approximately 67% of the drums retrieved were severely breached. Free liquid leaked from about 6% of the drums, and 5% were externally alpha-contaminated. Although alpha-contamination levels often exceeded 2 x 10^6 cpm, available equipment and established operating and safety procedures protected personnel and prevented any release of contamination into the environment. Under the Early Waste Retrieval Project, the following studies and tests relating to buried waste retrieval were conducted: a transuranic isotope migration study was performed in support of the Programmatic Environmental Impact Statement for the Long-Term Management of the Defense Transuranic Waste at the Idaho National Engineering Laboratory; strip curtains were tested and used successfully for contamination control; a waste compactor was purchased and used to compact loose and self-generated waste into 208-l drums; and dust and airborne contamination control tests were performed using soil binders and fabric material.

54237 (UCID—18119) **Groundwater recharge and discharge scenarios for a nuclear waste repository in bedded salt.** Carpenter, D.W.; Steinborn, T.L.; Thorson, L.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Mar 1979. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

Twelve potential scenarios have been identified whereby groundwater may enter or exit a nuclear waste repository in bedded salt. The 12 scenarios may be grouped into 4 categories or failure modes: dissolution, fracturing, voids, and penetration. Dissolution modes include breccia pipe and breccia blanket formation, and dissolution around boreholes. Fracture modes include flow through preexisting or new fractures and the effects of facies changes. Voids include interstitial voids (pores) and fluid inclusions. Penetration modes include shaft and borehole sealing failures, undetected boreholes, and new mines or wells constructed after repository decommissioning. The potential importance of thermal effects on groundwater flow patterns and on the recharge-discharge process is discussed. The appropriate levels of modeling effort, and the interaction between the adequacy of the geohydrologic data base and the warranted degree of model complexity are also discussed.

54238 (UCRL—15048) **Supplementary analysis of nuclear waste management options.** Koplik, C.M.; Pollak, G.D.; Ross, B.I. (Analytic Sciences Corp., Reading, MA (USA)). 15 Jun 1979. Contract W-7405-ENG-48. 60p. (TR—1103-1-2). Dep. NTIS, PC A04/MF A01.

This report describes studies pertaining to long-term risks from the disposal of high-level nuclear waste in deep mined cavities. The results presented supplement peviously reported work. Previously studied scenarios are examined in greater depth, and the analysis is extended to deal with alternative fuel cycles.

54239 (UCRL—52785) **Design of a variable-flow-rate, single-pass leaching system.** Weed, H.C.; Jackson, D.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

We have designed leaching systems for experiments on several kinds of solids, including glassy debris from underground nuclear explosions at Nevada Test Site (puddle glass), refractory compositions for retention of radioactive nuclear reactor waste, and spent reactor fuel. The system used on puddle glass has a continuously variable flow rate from 13 to 460 cm^3/d, a temperature range from 25 to 75°C, operating capacity for up to 20 simultaneous experiments, and one-pass operation with continuous exposure of samples to fresh solution. Results obtained on puddle glass are in qualitative agreement with those on silicate glasses designed for isolation of nuclear reactor waste.

54240 (USGS—1543-3) **Summary of hydraulic tests and hydrologic data for holes UE16d and UE16f, Syncline Ridge area, Nevada test site.** Dinwiddie, G.A.; Weir, J.E. Jr. (Geological Survey, Denver, CO (USA)). Sep 1979. Contract EW-78-I-08-1543. 30p. Dep. NTIS, PC A03/MF A01.

Argillite in the Eleana Formation of the Syncline Ridge area was investigated to determine its suitability for storing radioactive waste. Two exploratory holes were drilled during fiscal year 1977; this report summarizes geohydrologic information obtained from these holes. Dual-string, reverse-circulation drilling in the lower part of hole UE16f did not solve all problems associated with drilling argillite; however, more experience with this technique may be helpful in drilling holes that will be more suitable for hydraulic testing in argillite and other fine-grained rock. The Tippipah Limestone, which overlies the Eleana Formation at hole UE16d, is highly transmissive--more than 300 square meters per day for a 24-hour pumping test at a rate of 3,100 cubic meters per day, (about 36 liter per second). The argillite and unfractured quartzite of the Eleana Formation have extremely low permeabilities. Hydraulic heads increase markedly with depth, indicating a potential for upward flow. For example, the lowest hydraulic potential in UE16d was 230 meters below land surface for the interval 316-465 meters in depth, and the highest potential was less than 116 meters below land surface for the interval 645-914 meters in depth. Analyses of five water samples obtined from the holes indicate, in general, that water from the Eleana Formation is predominantly sodium bicarbonate, and water from the Tippipah Limestone is predominantly calcium-magnesium bicarbonate. The age of the water, uncorrected, was determined to be 14,000-16,000 yrs for water from the Tippapah Limestone, and as much as 21,000 years for water from the Eleana Formation. 10 figures, 2 tables.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54234, 55515, 55516, 55517, 55519, 55541, 55542, 55543, 55545, 55605, 55609, 55610, 55611, 55614

54241 (CONF-791103—5) **Determination of nuclear waste form leach rates by activation analysis.** Schuman, R.P. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Activation analysis was used to determine the leach rates of Na, Mo, Cs, Ba, La, Nd, Sm, Hf, and U by distilled water from two simulated glasses: zirconia calcine and lanthanide-actinide calcine. (DLC)

54242 (RFP—2967) **Plutonium in soil adjacent to Rocky Flats plant.** Hume, M.W.; Illsley, C.T. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1979. Contract EY-76-C-04-3533. 4p. (CONF-791103—1). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

In 1975, lawsuits were filed claiming contaminated lands adjacent to the plant. Five remote as well as 89 sites on lands under litigation were sampled using four sampling techniques at each site. An additional 71 sites were sampled using the Rockwell International technique. No results approached the EPA proposed guideline screening level of 200 mCi/km^2, although numerous sites to the last of the plant exceed 2 d/m/g (10 mCi/km^2). (DLC)

54243 (RHO-SA—87) **Variables affecting sorption and transport of radionuclides in Hanford subsoils.** Barney, G.S. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Dec 1978. Contract EY-77-C-06-1030. 6p. (CONF-781250—2). Dep. NTIS, PC A02/MF A01.

From Science underlying waste management conference; Boston, MA, USA (1 Dec 1978).

Regression equations relating K/sub d/ to significant variables have been obtained using a Box-Behnken experimental design. Results are given in equations where X_1, X_2, X_3, and X_4 are molarities of K^+, Na^+, Ca^{2+}, and NO_3^-, respectively and X_5 is the humic acid concentration in mg/liter. Units for K/sub d/ values are ml/g. (1) ln K/sub d/ (Cs) = 16.892 - 1928X_1 - 173X_2 + 0.194X_5 + 71000X_1^2 + 1000X_2^2 - 0.005X_5^2 + 13000X_1X_2 (2) ln K/sub d/ (Sr) = 3.987 - 97.332X_3 - 14.322X_2 + 0.42X_5 + 507.611X_2^2 - 0.001X_5^2 + 163.449X_3X_5 (3) ln K/sub d/ (Co) = 6.316 + 4000X_1^2 - 0.001X_5^2 - 1000X_4X_1 (4) ln K/sub d/ (Ru) = 2.955 - 107.99X_4 + 0.251X_5 + 523.929X_4^2 - 0.006X_5^2 + 0.79X_4X_5. The proportion of the total variation accounted for by each of these equations is 0.8135, 0.9852, 0.748, and 0.9624, respectively.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 54237, 54239

54244 (PNL—2549(Supp.)) **Supplement to safety analysis report. 306-W building operations safety requirement.** Richey, C.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 36p. Dep. NTIS, PC A03/MF A01.

The operations safety requirements (OSRs) presented in this report define the conditions, safe boundaries, and management control needed for safely conducting operations with radioactive materials in the Pacific Northwest Laboratory (PNL) 306-W building. The safety requirements are organized in five sections. Safety limits are safety-related process variables that are observable and measurable. Limiting conditions cover: equipment and technical conditions and characteristics of the facility and operations necessary for continued safe operation. Surveillance requirements prescribe the requirements

for checking systems and components that are essential to safety. Equipment design controls require that changes to process equipment and systems be independently checked and approved to assure that the changes will have no adverse effect on safety. Administrative controls describe and discuss the organization and administrative systems and procedures to be used for safe operation of the facility. Details of the implementation of the operations safety requirements are prescribed by internal PNL documents such as criticality safety specifications and radiation work procedures.

54245 (UCRL—15080) **Seismic risk analysis for the Atomics International Nuclear Materials Development Facility, Santa Susana California.** (TERA Corp., Berkeley, CA (USA)). 29 Dec 1978. Contract W-7405-ENG-48. 49p. Dep. NTIS, PC A03/MF A01.

This report presents the results of a detailed seismic risk analysis of the Nuclear Materials Development Facility (NMDF) operated by Atomics International at Santa Susana, California. The historical seismic record was established after a review of available literature, consultation with operators of local seismic arrays and examination of appropriate seismic data bases including the USGS, California Institute of Technology and NEIS data bases. The resulting seismic record, covering the period 1969 to 1977, was used to identify all possible sources of seismicity that could affect the site. The best estimate curve indicates that the facility will experience 30% g with a return period of 55 years and 60% g with a return period of 750 years.

54246 (UCRL—15082) **Seismic risk analysis for the Westinghouse Electric facility, Cheswick, Pennsylvania.** (TERA Corp., Berkeley, CA (USA)). 21 Oct 1977. Contract W-7405-ENG-48. 47p. Dep. NTIS, PC A03/MF A01.

This report presents the results of a detailed seismic risk analysis of the Westinghouse Electric plutonium fuel development facility at Cheswick, Pennsylvania. This report focuses on earthquakes. The historical seismic record was established after a review of available literature, consultation with operators of local seismic arrays and examination of appropriate seismic data bases. Because of the aseismicity of the region around the site, an analysis different from the conventional closest approach in a tectonic province was adapted. Earthquakes as far from the site as 1,000 km were included, as were the possibility of earthquakes at the site. In addition, various uncertainties in the input were explicitly considered in the analysis. For example, allowance was made for both the uncertainty in predicting maximum possible earthquakes in the region and the effect of the dispersion of data about the best fit attenuation relation. The attenuation relationship is derived from two of the most recent, advanced studies relating earthquake intensity reports and acceleration. Results of the risk analysis, which include a Bayesian estimate of the uncertainties, are presented as return period accelerations. The best estimate curve indicates that the Westinghouse facility will experience 0.05 g every 220 years and 0.10 g every 1400 years. The accelerations are very insensitive to the details of the source region geometries or the historical earthquake statistics in each region and each of the source regions contributes almost equally to the cumulative risk at the site.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 54834

54247 (CONF-790707—16) **Enhancement of loss detection capability using a combination of the Kalman Filter/Linear Smoother and controllable unit accounting approach.** Pike, D.H.; Morrison, G.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

An approach to loss detection is presented which combines the optimal loss detection capability of state estimation techniques with a controllable unit accounting approach. The state estimation theory makes use of a linear system model which is capable of modeling the interaction of various controllable unit areas within a given facility. An example is presented which illustrates the increase in loss detection probability which is realizable with state estimation techniques. Comparisons are made with a Shewhart Control Chart and the CUSUM statistic.

54248 (NUREG/CR—0777) **Digraph-fault tree methodology for the assessment of material control systems.** Lambert, H.E.; Lim, J.J.; Gilman, F.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 May 1979. Contract W-7405-ENG-48. 184p. (UCRL—52710). Dep. NTIS, PC A09/MF A01.

The Lawrence Livermore Laboratory, under contract to the United States Nuclear Regulatory Commission, is developing a procedure to assess the effectiveness of material control and accounting systems at nuclear fuel cycle facilities. The purpose of a material control and accounting system is to prevent the theft of special nuclear material such as plutonium or highly enriched uranium. This report presents the use of a directed graph and fault tree analysis methodology in the assessment procedure. This methodology is demonstrated by assessing a simulated material control system design, the Test Bed.

54249 (NUREG/CR—0923) **Sensitivity studies using the TRNSM 2 computerized model for the NRC physical protection project. Final report.** Anderson, G.M. (ORINCON Corp., La Jolla, CA (USA)). Aug 1979. Contract EY-76-C-04-0789. 146p. (SAND—78-8196). Dep. NTIS, PC A07/MF A01.

A computerized model of the transportation system for shipment of nuclear fuel cycle materials is required to investigate the effects on fleet size, fleet composition and efficiency of fleet utilization resulting from changes in a variety of physical and regulatory factors, including shipping requirements, security regulations, work rules, maintenance requirements, and vehicle capacities. Such a model has been developed which provides a capability for complete sizing requirements studies of a combined aircraft and truck fleet. This report presents the results of a series of sensitivity studies performed using this model. These studies include the effects of the intinerary optimization criteria, work rules, and maintenance policies. These results demonstrate the effectiveness and versatility of the model for investigating the effects of a wide variety of physical and regulatory factors on the transportation fleet.

54250 (RFP—2913) **Safeguards instrumentation for the new Rocky Flats processing facility.** Haas, F.X.; Gaskins, R.D.; Lawless, J.L.; Minges, G.P.; Roberts, O.K. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1979. Contract EY-76-C-04-3533. 20p. (CONF-790707—31). Dep. NTIS, PC A02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

This paper describes the safeguards instrumentation planned for the plutonim Waste Processing and Recovery Facility under construction at Rocky Flats Plant. Descriptions are given of the new plutonium Recovery Facility, the material handling systems and the nondesctructive assay equipment.

54251 (RHO-SA—96) **Field nondestructive assay measurements as applied to process inventories.** Westsik, G.A. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Aug 1979. Contract EY-77-C-06-1030. 15p. (CONF-790707—29). Dep. NTIS, PC A02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

An annual process equipment holdup inventory measurement program for a plutonium processing plant was instituted by Rockwell Hanford Operations (Rockwell) at Richland, Washington. The inventories, performed in 1977 and 1978, were designed to improve plutonium accountability and control. The inventory method used field nondestructive assay (NDA) measurement techniques with portable electronics and sodium iodide detectors. Access to and movement of plutonium in work areas was curtailed during the inventory process using administrative controls. Comparison of the two annual inventories showed good reproducibility of results within the calculated error ranges. For items where no plutonium movement occurred and which contained greater than 20 grams plutonium, the average measurement difference between the two inventories was 22%. The procedures and equipment used and the operational experience from the inventories are described.

54252 (SAND—77-1936(Rev.)) **Nuclear material operations manuals.** Tyler, R.P. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 340p. Dep. NTIS, PC A15/MF A01.

This manual is intended to provide a concise and comprehensive documentation of the operating procedures currently practiced at Sandia Laboratories with regard to the management, control, and accountability of radioactive and nuclear materials. The manual is divided into chapters which are devoted to the separate functions performed in nuclear material operations-management, control, accountability, and safeguards, and the final two chapters comprise a document which is also issued separately to provide a summary of the information and operating procedures relevant to custodians and users of radioactive and nuclear materials. The manual also contains samples of the forms utilized in carrying out nuclear material activities. To enhance the clarity of presentation, operating procedures are presented in the form of playscripts in which the responsible organizations and necessary actions are clearly delineated in a chronological fashion from the initiation of a transaction to its completion.

54253 (SAND—79-1111C) **Activated denial systems for safeguards application.** Kane, J.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-790707—20). Dep. NTIS, PC A02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

Activated denial concepts are being developed and systems tested that can, on command, thwart or delay an adversary from accomplishing an act which a safeguard system is designed to prevent. This paper identifies the major components of an activated denial system, describes some of the attributes of denial materials, and discusses hardware requirements for these systems.

54254 (SAND—79-1397C) **Experimental Computerized Alarm Display System.** Davis, R.F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-790707—21). Dep. NTIS, PC A02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

Computer-based systems are being used in an increasing number of nuclear materials management and safeguards applications. The goal of the Experimental Computerized Alarm Display System (ECADS) project is to demonstrate and evaluate the effectiveness of a variety of hardware components and software techniques for security console communication and interaction. The focus of these investigations is on the human factors of the man-machine interaction. The ECADS hardware and software facilities will be described. These facilities are available to DOE personnel to assist in the preparation of definitive design and/or procurement specifications for equipment that will be used in security operations centers.

54255 (STI/PUB—497(Vol.1)) **Nuclear safeguards technology, 1978. Proceedings series.** (International Atomic Energy Agency, Vienna (Austria)). 1979. 770p. (In several languages). (CONF-781007—P1). IAEA, Vienna, Austria.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Volume 1 contains papers from the following sessions: facility design criteria for international safeguards; electronic processing safeguards information; safeguards technology for uranium enrichment facility; safeguards technology for fuel fabrication facilities; safeguards for nuclear power reactors; containment and surveillance; and destructive and non-destructive measurement technology. Individual papers were processed.

54256 (LA-tr—79-39) **Consequences of large-scale implementation of nuclear energy in the Federal Republic of Germany. Part VI. Nuclear material control.** Avenhaus, A. (ed.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1979. Translation of KFK—2706. 41p. Dep. NTIS, PC A03/MF A01.

Nuclear material requires special protective measures because of its great economic importance, its toxicity (especially plutonium), and its military value. Usually the total complex of nuclear material control is subdivided into (a) physical protection measures which are applied to protect nuclear material and installations, and (b) international safeguards which are intended to reduce the hazard of nuclear proliferation. The present technological and organizational status and some open questions of international nuclear material safeguards are presented in some detail. Physical protection will be touched upon only briefly, as the measures to be taken here do not differ, in principle, from those to be taken elsewhere.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 54218, 54219, 54220, 54222, 54223, 54224, 54225, 54227

54257 (INIS-mf—4684) **Proposed decision of the Council to amend Council decision No. 74/642 on the establishment of a research and training programme of the European Atomic Community on the recycling of plutonium in LWR reactors.** (Bundesrat, Bonn (Germany, F.R.)). Jun 1978. vpp. (In German).

Prolongation of the duration of the programme, which was to be terminated in 1978, until 1979.

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

54258 (UCRL—80949) **Fabrication of glass laser fusion targets.** Elsholz, W.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1978. Contract W-7405-ENG-48. 17p. (CONF-7806159—1). Dep. NTIS, PC A02/MF A01.

From American Scientific Glass Blowers Society symposium; San Jose, CA, USA (19 Jun 1978).

Fusion research is being vigorously pursued at Lawrence Livermore Laboratory and other laboratories throughout the world with the ultimate goal of generating power from controlled thermonuclear reactions. Two approaches to the problem of constructing glass targets with diameters of 100 to 500 μ and wall thicknesses from 1 to 10 μ are described.

REPROCESSING

54259 (UCRL—52801) **Tritium release from a nonevaporable getter-pump cartridge exposed to moist air at ambient temperature.** Biel, T.J.; Sherwood, A.E.; Singleton, M.F.; Alire, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1979. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

The amount of tritium released when a commercially available getter-pump cartridge was exposed to moist air at ambient temperatures was measured. The cartridge consisted of Zr-Al powder pressed onto an iron substrate, which is the type of cartridge proposed for use in the Tokomak Fusion Test Reactor. While the initial release of tritium was rapid the total activity released was lss than 0.005% of the cartridge loading. Of this amount, at least 80% was released as tritiated water. 8 figures.

BY-PRODUCTS

54260 (BNL—26331) **High temperature electrolysis.** Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-791103—16). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

An idealized flowsheet for a high temperature electrolysis fusion synthetic fuel plant is given. Two blanket module types are indicated; the first type heats steam or CO_2 to high temperatures for the HTE cells ($T \geqq 1000°C$) while the second heats a working fluid for an electrical power cycle and breeds tritium. (MOW)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 54194

HEAVY WATER PRODUCTION

54261 (UCID—17736-78-5) **Development of advanced concepts for improved heavy water production technology. Quarterly progress report, October 1, 1978-December 31, 1978.** Aldridge, F.T.; Herman, I.P.; Marling, J.B.; Wood, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1979. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A02/MF A01.

Research on advanced concepts for improved heavy water production technology narrowed its focus from three to two significantly different processes. The process based on infrared laser-induced addition reactions has been discontinued because recent experiments clearly indicated no product yield due to laser excitation. In contrast, a significant breakthrough has been achieved for the process based on CO_2-laser dissociation of the halocarbon derivative CF_3CHCl_2, or Freon 123. A two order-of-magnitude increase in system operating pressure to 100 torr was achieved while maintaining a 1200-fold single-step deuterium enrichment factor by utilizing two-nanosecond duration CO_2 laser pulses for dissociation. This operating pressure is acceptable for practical utilization of this process for large-scale deuterium separation. A second candidate molcule, CHF_3 (trifluoromethane), exhibits deuterium-bearing photoproduct with unit yield, similar to Freon 123, but with prospects for even higher deuterium optical selectivity and enrichment factors. A series of Ca-Ni-Cu alloys are being examined to determine the optimum composition for use in deuterium separation by intermetallic hydride chromatography--the second attractive process under continuing intensive investigation.

RADIATION SOURCES

54262 (GEPP-TIS—432) **All-metal uranium bed loading system.** Eichman, C.C. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 20 Jul 1979. Contract EY-76-C-04-0656. 27p. Dep. NTIS, PC A03/MF A01.

The uranium bed processing system is essentially a vacuum system designed to transfer tritium gas from a large shipping container into small, portable containers called beds. The portable beds, designed to contain specific amounts of tritium or deuterium gas, are attached to various production systems for the purpose of hydriding occluder films in the production of neutron generators. The beds are constructed of stainless steel and contain uranium that is hydrided up to 50% capacity with tritium or deuterium gas. This technique not only makes it easy to load a bed, but also to recover surplus gas from a production system after the neutron generator hydriding process has been completed. The process development activities were directed toward solving and developing processing procedures for: (1) purifying the tritium gas; (2) reducing the protium gas; (3) removing helium (due to tritium decay) from the vacuum system; (4) eliminating hydrocarbon contamination; (5) increasing helium pumping speed with ion pumps; (6) providing multiple bed processing capability; (7) measuring pressure accurately; and (8) detect system leaks and obtain residual gas analyses of the system.

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 55177

54263 (SAND—78-1847) **Beneficial Uses Program. Progress report, period ending December 31, 1977.** (Sandia Labs., Albuquerque, NM (USA)). Nov 1978. Contract EY-76-C-04-0789. 39p. Dep. NTIS, PC A03/MF A01.

The Beneficial Uses Program is a comprehensive program to develop the necessary technologies for cost-beneficial uses of existing and future surplus radioactive materials. The major portion of the work at Sandia is concentrated in two sub-programs: the Waste Resources Utilization Program and the Separation Technology and Source Development Program. Progress is reported on: (1) the Sandia Irradiator for Dried Sewage Solids; (2) bacteriology; (3) mycology; (4) virology; (5) animal feeds containing irradiated sewage solids; (6) use of irradiated sewage sludge as fertilizer; and (7) development of ^{90}Sr and ^{137}Cs radiation sources obtained from radioactive wastes. (TFD)

54264 (SAND—79-0629) **Summary of recent developments in the Sludge Irradiation Program at Sandia Laboratories.** Morris, M.E.; Sivinski, J.S.; Brandon, J.R.; Neuhauser, K.S.; Ward, R.L. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 57p. Dep. NTIS, PC A04/MF A01.

Sandia Laboratories has shifted the emphasis of its Sewage Sludge Irradiation Program toward treating dried sewage sludges rather than liquid sludges for the following reasons: (1) cities' interests in composting sewage sludge before final disposal, (2) disinfection may be required for increased public use of composted or dried sludge, and (3) disinfection of dried sludge costs less than disinfection of liquid sludge. As a result of this shift, the Sandia Irradiator for Dried Sewage Solids (SIDSS) was designed and is near completion. The irradiator will treat up to 8 tons/day of solids with a 1 megarad absorbed dose. A bucket conveyor will transport the sewage sludge past a 1 megacurie cesium-137 γ-ray source. If a lower dose than 1 megarad is acceptable for disinfection, the daily throughput of the irradiator will be correspondingly increased. The irradiator is designed so that the cesium-137 γ-ray sources used to charge the facility can be manipulated underwater. After source unloading is complete, the water will be drained and the irradiator will be operated dry. Either bagged or bulk solids can be irradiated with the system. In April 1979, the facility will be charged with cesium-137.

54265 (SAND—79-1089) **Beneficial Uses Program. Progress report, period ending March 31, 1979.** (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 58p. Dep. NTIS, PC A04/MF A01.

The Beneficial Uses Program is a comprehensive program to develop the necessary technologies for cost-beneficial uses of existing and future surplus radioactive materials. The major portion of the work at Sandia is concentrated in two sub-programs: the Waste Resources Utilization Program and the Separation Technology and Source Development Program. Progress is reported on: (1) the Sandia Irradiator for Dried Sewage Solids; (2) bacteriology; (3) mycology; (4) virology; (5) animal feeds containing irradiated sewage solids; (6) use of irradiated sewage sludge as fertilizer; and (7) development of ^{137}Cs radiation sources obtained from radioactive wastes. (TFD)

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 55144

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 54752, 54753

ELECTROLYSIS

REFER ALSO TO CITATION(S) 54260

54266 (LA—7592-MS, pp 5.1-5.15) **Hydrogen from high-temperature electrolysis of steam.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

The theoretical basis for electrolysis, high-temperature electrolysis (electrolyte, anodes, cathodes, interconnections), higher temperature electrolyzer programs (Dornier Systems GmbH, Westinghouse Corporation, Brookhaven National Laboratory), comparative economics of high temperature and conventional electrolysis, and plasma reactor heat source are discussed briefly.

THERMOCHEMICAL PROCESSES

54267 (LA—7592-MS, pp 9.1-9.42) **Thermochemical production of hydrogen from water, a critical review.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

The current status is assessed of thermochemical hydrogen technology as regards process chemistry, preliminary chemical engineering design, and techno-economics for a number of cycles undergoing active research and development throughout the world. The cycles reviewed are: the hybrid sulfuric acid cycle-Westinghouse; the sulfuric acid-hydrogen iodide cycle-General Atomic; the hybrid sulfuric acid-hydrogen bromide cycle-Euratom; the hybrid bismuth sulfate cycle-Los Alamos Scientific Laboratory; and the magnesium-iodine cycle-NCLI, Japan.

STEAM REFORMER PROCESSES

54268 **Reforming furnace having ceramic-coated tubes.** Edridge, A.J. (to Chevron Research Company). US Patent 4,161,510. 17 Jul 1979. Filed date 18 Dec 1975. 2p.

The useful life of catalyst-filled tubes exposed to a heat source in a steam-light hydrocarbon reforming furnace is increased by painting at least a portion of the exposed surface of at least one tube with a liquid which forms a ceramic-like reflective surface on the tube.

COAL GASIFICATION

REFER ALSO TO CITATION(S) 54056

STORAGE

CHEMISORPTION

54269 (BNL—26523) **Proceedings of the hydride storage reservoir symposium/workshop.** Rosso, M.J. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 79p. (CONF-7806165—). Dep. NTIS, PC A05/MF A01.

From Hydride storage reservoir symposium; Upton, NY, USA (20 Jun 1978).

The use of metal hydrides as a storage medium for hydrogen is generally accepted to be a viable and useful technology. A number of scientific and engineering considerations remain to be answered and they provide the justification for this DOE sponsored Symposium/Workshop. The conference was held on June 20 and 21, 1978 at Brookhaven National Laboratory, and included a limited number of invited metal hydride experts. The main areas of interest, which set the guidelines for the twelve presentations and the workshop topics, included Hydride Reservoir Container Materials, Hydride Reservoir Internal Engineering Design, Hydride Bed Heat and Mass Transfer, and Hydride Fundamental Properties. These Proceedings include the abstracts of each of the formal presentations and the summations of each of the Workshop Chairmen. The full text of two papers which were not presented are included as Appendix B. The titles are Development of low cost nickel-rare earth hydrides for hydrogen storage and an exact solution of diffusion and absorption of hydrogen in uranium followed by fracture of the hydride.

SAFETY

54270 (LA-UR—79-583) **Assessment of environmental and safety problems in hydrogen energy systems.** Edeskuty, F.J.; Bartlit,

J.R.; Carlson, R.V. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-790901—3). Dep. NTIS, PC A02/MF A01.

From 15. international congress on refrigeration; Venice, Italy (23 Sep 1979).

Numerous suggestions have been made for the use of hydrogen as a portable or transportable fuel. To effect safely an expanded use of hydrogen requires fundamental knowledge of the appropriate safety problems as well as mechanisms to ensure the proper design of equipment and techniques used in its storage, shipment, and use. Most likely methods of shipment consist of an extension of existing technology; namely, gas transmission by pipeline and bulk transportation of hydrogen as a cryogenic liquid. While these are well developed, safety and technological problems still exist and include such issues as dispersion of hydrogen releases, behavior of hydrogen on combustion, and hydrogen embrittlement. Safe transportation and handling of hydrogen can be enhanced by uniformity of codes and regulations. Hydrogen use as a fuel is not totally benign from an environmental standpoint; however, the combination of production and end use is generally more acceptable for hydrogen than for alternative fuels.

54271 (LA-UR—79-1416) **Safety of liquid hydrogen in air transportation.** Edeskuty, F.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 18p. (CONF-790942—1). Dep. NTIS, PC A02/MF A01.

From Hydrogen in air transportation conference; Stuttgart, F.R. Germany (10 Sep 1979).

Safety is an important consideration in the use of hydrogen in air transportation. The use of cryogenic hydrogen involves the hazards arising from low temperatures as well as those of combustibles. An understanding of safety-related properties and their consequences is necessary for safe design and operation. Here we discuss hydrogen properties and their effect upon airline operation. Several safety problems require additional experimental work before they can be sufficiently understood. To maintain the good safety record associated with the previous use of liquid hydrogen requires a continuing safety engineering effort including planning, design, construction of equipment, and continuous training of personnel.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54270

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

54272 **Substituted natural gas via steam reforming of kerosene.** Ward, D.J. (to UOP Inc.). US Patent 4,160,649. 10 Jul 1979. Filed date 25 Aug 1978. 10p.

A multiple-stage steam reforming process is described for producing a substitute natural gas from kerosene boiling range hydrocarbons. Initially, a lower-boiling feedstock is steam reformed, and a portion of the effluent is subjected to hydrogen-producing conditions to provide a vaporous phase enriched in hydrogen content. This vaporous phase is utilized throughout the reaction zone circuit to decrease the extent to which carbon becomes deposited upon the various catalytic composites, and especially with respect to those reaction zones in which the kerosene boiling range hydrocarbons are processed. Gasification of the kerosene fractions is effected at a minimum catalyst temperature of about 840°F (448.9°C) and a maximum catalyst temperature of about 1,000°F (537.8°C).

54273 **Preparation and use of supported potassium (or rubidium)-Group VIII-metal cluster catalysts in CO/H_2 Fischer-Tropsch synthesis reactions.** McVicker, G.B.; Vannice, M.A. (to Exxon Research and Engineering Co.). US Patent 4,154,751. 15 May 1979. Filed date 1 Mar 1978. 10p.

This invention relates to unique supported potassium (or rubidium)-Group VIII-metal cluster catalysts which are useful in CO/H_2 reactions (Fischer-Tropsch synthesis reactions). The novel catalysts of the instant invention are prepared by depositing well characterized potassium (or rubidium)-Group VIII-metal carbonyl cluster complexes onto high surface area supports. Following a subsequent reduction, the precursor bimetallic cluster complexes are decomposed on the support surface forming a potassium (or rubidium) promoted Group VIII-metal cluster catalyst in which the potassium (or rubidium) and Group VIII metals are intimately associated. These unique, highly promoted cluster catalysts have been found to demonstrate high Group VIII-metal dispersions and enhanced Fischer-Tropsch activities and selectivities for producing olefinic and paraffinic hydrocarbons. In addition methane formation is dramatically reduced over the supported bimetallic cluster catalysts of the instant invention when compared to conventionally prepared supported potassium (or rubidium) promoted Group VIII-metal catalysts. 3 tables.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 54031

54274 (COO—2983-11) **Energy and protein production from pulp mill wastes. Quarterly report, December 15, 1978-March 15, 1979.** Jurgensen, M.F.; Patton, J.T. (Michigan Technological Univ., Houghton (USA)). 15 Mar 1979. Contract EY-76-S-02-2983. 7p. Dep. NTIS, PC A02/MF A01.

The objective for the past quarter included reversing the decline in productivity from the methane fermenters, confirming methane and yeast production from acetate, and making trial runs on kraft mill and semichemical mill effluents. Although methane production remained low (20 cc/hr) addition of 2% methanol doubled production. Progress has been made on identifying possible viruses that might be preventing higher methane production. Confirmation that acetate can be used as a substrate for methane production has been obtained. An initial test on the Decker filtrate from a kraft mill gave 20 cc/hr methane production.

54275 (COO—4455-2) **Anaerobic biological treatment of liquid wastes from pyrolysis processes. Progress report, April 1, 1977-March 31, 1979.** Dague, R.R. (Iowa Univ., Iowa City (USA)). 15 May 1979. Contract EC-77-S-02-4455. 61p. Dep. NTIS, PC A05/MF A01.

Experimental work on this project has shown that gas scrubber wastes from the PUROX pyrolysis process are high in organics that are toxic to anaerobic biological treatment systems. These include polynuclear aromatics and phenolic compounds, some of which are known to be carcinogenic and mutagenic. When PUROX wastes were fed in an amount of only five percent of the total daily feed (16.6 ml in 333.3 ml) to 5-liter, completely-mixed, suspended-growth anaerobic reactors, operating at a solids retention time of 15 days and a temperature of 35°C, the biological process was immediately and severely retarded after only one feeding. Subsequent work has shown that the suspended growth anaerobic system can be acclimated to a continuous feeding of PUROX wastes up to 90 ml/day out of a total feed of 333.3 ml/day without significant inhibition. Also, attached growth anaerobic filters have been acclimated to accept a continuous feeding of PUROX wastes up to 40% of the COD of the feed. Experiments with carbon adsorption indicate that PUROX wastes can be adsorbed to a high degree. Isotherms indicate an adsorptive capacity of between 0.60 and 0.86 grams of COD per gram of carbon. Carbon is being evaluated as a method of pretreatment, co-treatment, or separate treatment for application to the pyrolysis wastes. Work is continuing to increase the percentage of PUROX wastes in the feed to the anaerobic systems. The suspended growth systems will be operated in the anaerobic contact mode (high solids retention, low hydraulic retention) with the idea that such operation will reduce the build-up of inhibitory metabolites in the reactor. Such a build-up is the probable cause of inhibition after the PUROX wastes in the feed exceed a certain percentage.

54276 (TID—29306) **Evaluation of the proposed bio-gas project at Lamar, Colorado.** Jones, J.L. (SRI International, Menlo Park, CA (USA)). 30 Jun 1978. Contract EW-78-X-03-0357. 71p. Dep. NTIS, PC A04/MF A01.

The proposed bio-gas cattle manure processing plant at Lamar, Colorado, would probably not operate as planned because of apparent flaws in the conceptual design of the algae system for water renovation. Although there is no reason to suspect that the anaerobic digestion portion of the plant will not produce a CH_4-rich fuel gas (assuming an adequate quality of water for slurry preparation), it is not apparent that the design is optimal in terms of producing a high value cattle refeed product. The estimate of the investment cost for the proposed plant (exclusive of the algae system for water renovation) appears to be reasonable based on comparisons with SRI's previous estimates of anaerobic digestion facilities for cattle manure. The economic feasibility of the project is highly dependent on the revenue to be obtained from sale of the digester residue for cattle refeed, especially if one assumed CH_4 sale at a price below $2 per million Btu as specified in the subject report.) This cattle refeed aspect of the project appears to be a high risk area. It appears to be premature to embark on the construction of a large commercial manure processing plant at Lamar. A more prudent plan would be to construct and operate a process development unit (considerably larger than the current pilot plant) to gather more process design data and to produce suitable quantities of the refeed product for further cattle feeding trials.

54277 Fuel gas production. Hunt, H.H.; Worcester, H.S. US Patent 4,164,397. 14 Aug 1979. Filed date 16 Feb 1978. 8p.

A method of manufacturing fuel gas from lignocellulose material such as wood is described. Wood is converted to fuel gas in a descending bed reactor which encloses a descending bed of wood material. Gas produced in the reactor travels upwardly through and thence out from the top of the descending bed, with a portion of the gas being recirculated and introduced as reflow gas, together with air, to a combustion zone established at the base of the descending bed.

54278 Heat producing device. Bozdech, S.L.; Lipinski, T.E.; Allen, J.W.; Ryba, S.J.; Meacham, G.B.K.; Anthony, C. Jr.; Pattyn, D.L.; Bauer, F. (to DeKalb AgResearch, Inc.). US Patent 4,162,655. 31 Jul 1979. Filed date 13 Mar 1978. 6p.

A heat producing device utilizing solid carbonaceous material, especially material of cellulosic composition such as corn cobs, as fuel is described. The heat producing device includes a gasifier for the carbonaceous material. The gas outlet of the gasifier leads to a burner. A cyclonic burning chamber and particle separator are connected to the discharge of the burner. The cyclonic burning chamber and particle separator has a heat outlet and a particle discharge outlet. An adjustable air inlet and mixing chamber are installed in the heat outlet for adding ambient air to reduce the temperature of the heat discharged from the heat outlet. A discharge fan has an inlet connected to the mixing chamber and an outlet for discharging the heat received therefrom to a drying chamber or other heat utilizing source.

54279 Apparatus for the production of methane containing gas by hydrogasification. Feldmann, H.F. (to Syngas International, Ltd.). US Patent 4,152,122. 1 May 1979. Filed date 5 Dec 1977. 28p.

An improved system for producing methane-containing product gas by the hydrogasification process is described. With the system, solid municipal waste is comminuted and dried following which it is introduced to the lock hopper receivers for transference to an elongate hydrogasification reactor. Synthesis gas is introduced to a lower region of the reactor and the comminuted waste, including inorganic materials, is dried and converted to methane-containing product gas and char. The char is removed from the system by a variety of separation systems including cyclone separators or aspirators and the inorganic fractured waste materials pass through the reactor but are undamaged and in a sterile condition ideally suited for recovery. A gasification reactor is incorporated with the system which receives char from the process as well as oxygen to produce the synthesis gas utilized in the hydrogasification reactor. Where no inorganic materials are present, the organic materials may be introduced both to the gasification reactor to produce synthesis gas as well as to the hydrogasification reactor to produce char end product gas. The char is removed from the product gas and returned to the synthesis gas producing gasification reactor. Drying may be carried out utilizing a fluidized sand bed drying technique.

PREPARATION

PREPARATION FROM WASTES OR BIOMASS

54280 (DSE—3060-T1) **Design, fabrication and operation of a biomass fermentation facility. First quarterly report, October 1-December 31, 1978.** O'Neil, D.J.; Colcord, A.R.; Bery, M.K.; Day, S.W.; Roberts, R.S.; El-Barbary, I.A.; Havlicek, S.C.; Anders, M.E.; Sondhi, D. (Georgia Inst. of Tech., Atlanta (USA)). 1978. Contract ET-78-C-01-3060. 139p. Dep. NTIS, PC A07/MF A01.

The objective of this project is to design, fabricate, and operate a fermentation facility which will demonstrate on a pilot-scale level (3 oven-dry tons (ODT) per day of feedstock) the economic and technical feasibility of producing anhydrous ethyl alcohol from lignocellulosic biomass residues (wood, corn stover, and wheat straw principally). The resultant process development unit (PDU) will be flexibly designed so as to evaluate current and projected unit operations, materials of construction, chemical and enzymatic systems which offer the potential of significant technological and economic breakthroughs in alcohol production from biomass. The principal focus of the project is to generate fuels from biomass. As such, in addition to alcohol which can be used as a transportation fuel, by-products are to be directed where possible to fuel applications. The project consists of two parts: (1) conceptual design, and (2) detailed engineering design. The first quarter's activities have focused on a critical review of several aspects of the conceptual design of the 3 ODT/day PDU, viz.: (1) biomass cost, availability, and characterization; (2) pretreatment processes for lignocellulosic residues; (3) hydrolytic processes (enzymatic and acidic); (4) fermentation processes; (5) alcohol recovery systems; (6) by-product streams utilization; and (7) process economics.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 55128, 55129

HYDRO ENERGY

REFER ALSO TO CITATION(S) 55126

PLANT DESIGN AND OPERATION

54281 (CONF-790803—50) **Turbomachinery options for an underground pumped hydroelectric storage plant.** Blomquist, C.A.; Tam, S.W.; Frigo, A.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Various turbomachinery options for underground pumped hydroelectric storage (UPHS) plants are reviewed. Current technology indicates that the maximum head for single-stage, reversible, Francis-type pump turbines is 625 m; for separate, single-stage, Francis-type turbines and multistage pumps, 672 m; for tandem units consisting of separate multijet impulse turbines and multistage pumps, 1440 m; and for multistage, reversible, ungated Francis-type pump turbines, 1290 m. Engineering design studies conducted for Argonne National Laboratory indicated that heads for the single-stage reversible units could be extended to 1000 m, developing 500-MW output per unit. The studies also indicated that two-stage, reversible, Francis-type pump turbines with adjustable wicket gates could be developed for power outputs up to 500 MW at operating heads as high as 1500 m. Results of these studies, including performance and design data, are presented. Using the cost of a single-stage, reversible, Francis-type pump turbine as 1, the approximate cost of other turbomachines is: 1.55 for a single-gated, two-stage, reversible pump turbine; 1.67 for a double-gated, two-stage, reversible pump turbine; 1.9 for an ungated, multistage, reversible pump turbine; and 3.3 for a tandem unit (Pelton and pump).

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 55534

SOLAR ENERGY

54282 (BNL—50922) **Solar and geothermal energy utilization n SF-2: a sensitivity analysis.** Davitian, H.; LaSala, R.; Marcuse, W. (Brookhaven National Lab., Upton, NY (USA)). 5 Apr 1977. Contract EY-76-C-02-0016. 33p. Dep. NTIS, PC A03/MF A01.

A sensitivity analysis was conducted of the utilization levels for Solar, Geothermal, and Advanced Energy Systems (ASGA) technologies during the 1985-2000 time period. In particular, the sensitivity of the utilization levels was tested with respet to both analytical techniques and to specific parameter assumptions. The sensitivity to analytical techniques was examined insofar as certain criteria were examined to elucidate their importance in determining the level of use of the ASGA technologies. The criteria incorporated consideration of such factors as total cost of the energy system, environmental impacts, and resource use patterns. The parameter assumptions studied included costs of ASGA costs of ASGA technologies, costs of non-renewable resources, and limitations on the use of technologies and resources. (MHR)

54283 (DOE/TIC—10250) **Job creation potential of solar and conservation: a critical evaluation.** (Department of Energy, Washington, DC (USA). Office of Policy and Evaluation). 7 May 1979. 24p. Dep. NTIS, PC A02/MF A01.

A conceptual framework is outlined briefly for comparing the quantitative and qualitative aspects of job creation among energy alternatives. The state-of-the-art of employment impact analyses are described and evaluated. Job creation by solar and energy conservation are compared to LNG, conventional power plants, and nuclear power. (MHR)

54284 (SERI/SP—42-141) **National Solar Energy Education Directory. First edition.** O'Connor, K.; Corcoleotes, G.; Silversmith, J.A.; Kramer, K.A. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1979. Contract EG-77-C-01-4042. 300p. Dep. NTIS, PC A13/MF A01.

The directory lists institutions alphabetically by institution type within a state. A complete alphabetical index of institutions is found in the back of the Directory along with a cross reference to program and curriculum titles. Within each institution, programs and curricula offered, if any, are listed following the institution name, ID number (found in parentheses to the right of the institution name), address and phone number. All solar-related courses are then listed alphabetically by course title. If a course is offered within a program or curriculum, the program or curriculum name with which it is associated is printed. The Directory contains entries for nearly 700 post-secondary education institutions in the 50 states, the District of Columbia, Guam, and Puerto Rico.

54285 (UCRL—15053) **Solar/wind handbook for Hawaii: technical applications for Hawaii, the Pacific Basin and sites worldwide with similar climatic conditions.** Falicoff, W.; Koide, G.; Takahashi, P. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.; Hawaii Univ.--Hilo Coll. (USA); Hawaii State Dept. of Planning and Economic Development, Honolulu (USA)). May 1979. Contract W-7405-ENG-48. 647p. Dep. NTIS, PC A99/MF A01.

The techniques are presented for using solar energy and wind power in applications such as domestic hot water production, space cooling, process heating, and power generation. The findings and information are based upon conditions in Hawaii, but can apply to locations with similar environments such as the entire Pacific area. (MHR)

RESOURCES AND AVAILABILITY

54286 (ANL/SPG—14) **Solar availability for winter space heating: an analysis of the calendar period 1953-1975.** Asbury, J.G.; Maslowski, C.; Mueller, R.O. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 20p. Dep. NTIS, PC A02/MF A01.

Solar availability for space heating has been determined from an analysis of SOLMET data tapes for eight US sites. The tapes contain hourly readings of insolation and ambient temperature for the period 1953-1975. Scatter-diagrams of insolation versus heating degree-days, compiled on a daily basis, indicate a wide variation in insolation levels, even during periods of coldest weather. For seven of the eight sites, the peak-day backup energy required by a solar space heating system exceeded 85% of the peak-day energy requirement of a conventional (nonsolar) heating system.

54287 (BNL—50939) **Normal incident solar radiation measurements at Upton, New York.** Cottingham, J.G. (Brookhaven National Lab., Upton, NY (USA)). 24 Oct 1978. Contract EY-76-C-02-0016. 15p. Dep. NTIS, PC A02/MF A01.

Normal incident solar energy measurements made at Upton, L.I., New York are reported and analyzed relative to the total energy received on a horizontal surface. A new method for computing normal incident solar radiation is developed and used to study long term variations in this energy source at Upton and to estimate average values for other east coast locations.

54288 (DOE/ET/20175—1) **Solar radiation observation stations updated to 1979.** Carter, E.A.; Cristina, J.R.; Williams, B.B. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Apr 1979. Contract ET-78-S-05-5753. 98p. Dep. NTIS, PC A05/MF A01.

The type of sensing and recording equipment for 420 stations in the US are listed alphabetically by states. The stations are divided according to whether or not they are in the basic National Weather Service, NOAA, network. Reports of summarized solar radiation data are listed in an appendix. (MHR)

54289 (DOE/TIC—10193(Rev.1)) **Input data for solar systems.** Cinquemani, V.; Owenby, J.R. Jr.; Baldwin, R.G. (National Climatic Center, Asheville, NC (USA)). Aug 1979. Contract EX-76-A-29-1041. 203p. Dep. NTIS, PC A10/MF A01.

Normals (30-year mean values) of maximum, minimum, and average temperatures for a month or year, and of heating and cooling degree days are provided for 248 US stations. Average daily values of total hemispheric (global) solar radiation on a horizontal surface were based on corrected hourly measurements for 25 stations, derived values from corrected measurements for 25 stations, and derived values from the corrected measurements for the remaining 222 stations. (MHR)

ECONOMICS

REFER ALSO TO CITATION(S) 54328, 54380, 54381, 54436, 54449

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 54370, 54419, 54420, 54427, 54467

54290 (DOE/EDP—0034) **Environmental development plan ocean thermal energy conversion.** (Department of Energy, Washington, DC (USA)). Aug 1979. 53p. Dep. NTIS, PC A04/MF A01.

The present status and goals of the OTEC EDP program is described, and potential environmental, health, safety, and socio-legal-economic impacts relevant to the program are identified. These impacts emphasize key concerns, i.e., that are considered to be potentially most serious, that have near-term importance to the program, and for which current knowledge of effects and control strategies is inadequate. A management plan is presented for conducting and coordinating environmental research in concert with the development of appropriate technology. This will ensure that identified environmental concerns are resolved before significant public use of OTEC systems. The OTEC program is the largest element of DOE's ocean systems program, which also includes work toward developing technologies for converting other renewable ocean energy resources (waves, currents, and salinity gradients). The five major classes of environmental concerns associated with the deployment and operation of an OTEC system are those concerned with changes in oceanic properties, chemical pollution, operation of a manned platform, legal and institutional matters, and secondary impacts associated with site selection, construction, and operation of OTEC plants. This EDP proposes studies to address each of the key concerns and schedules the studies so that they provide informaion at the appropriate time during the test stages of OTEC development. The studies are designed to determine the scope and severity of each potential problem and to recommend remedial procedures or mitigating strategies. The EDP will be updated annually so that the research can be assessed and, if necessary, redirected.

54291 (DOE/EDP—0035) **Environmental development plan solar thermal power systems.** (Department of Energy, Washington, DC (USA)). Aug 1979. 46p. Dep. NTIS, PC A03/MF A01.

This EDP for the DOE Solar Thermal Power Systems Program briefly describes the goals of the program and identifies potential environmental, health, safety, and socioeconomic impacts relevant to solar thermal power systems (STPS), particularly those sited in the Southwest. These impacts are screened for key issues, i.e., those issues considered to be the most series in nature, that have near-term importance to the program, and for which current knowledge of effects and control is inadequate. A management plan is then presented for conducting and coordinating environmental research in concert with the technology development effort to ensure that identified environmental issues are resolved prior to significant public deployment of the technology. Key environmental concerns associated with the development and deployment of STPS have been identified by the March 1978 STPS EDP in the following subject areas: (1) site selection (including the question of water availability); (2) ecological and microclimatic effects; (3) working fluid handling and release modes; and (4) misdirected solar radiation. By the time a scale-up and commercialization decision must be made on solar thermal power applications, most of the required research on environmental problems should be completed or underway as a result of the R and D planned in this EDP.

54292 (LA—7945-TASE) **Institutional interactions with the solar supply industry.** Meyer, R.T.; Lansdowne, J.; Prythero, T.; Davidson, R. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 107p. Dep. NTIS, PC A06/MF A01.

Those institutional decision makers are identified and those issues are assessed that could significantly affect the solar energy conversion industry as it grows and attempts to mass-produce and distribute the small-scale solar technologies. Only those solar technologies scheduled for mass production and mass distribution are discussed.

54293 (SERI/TP—51-188) **Public attitudes and solar policy.** Weis, P.R. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1979. Contract EG-77-C-01-4042. 20p. (CONF-790107—11). Dep. NTIS, PC A02/MF A01.

From 3. national conference and exhibition on technology for energy conservation; Tucson, AZ, USA (22 Jan 1979).

Public attitude surveys are examined regarding support for government action on solar energy in general and for information dissemination and economic incentive programs in particular. Twenty-nine public attitude surveys with data relevant to solar energy policy were collected. Their findings were separated and recorded under major subject categories for analysis. There is significant support expressed in surveys for government action on solar energy, but nearly half of the respondents do not feel it should replace private effort. Over 70% of respondents say they like solar, but these positive attitudes do not translate directly into willingness

to purchase. Information programs and economic incentives elicit approval from well over half of respondents. General knowledge of the existence of solar energy is high, yet about 40% of sampled respondents still have not seen a solar collector. Over 80% do not know details necessary to a purchase decision. Perception of cost seems to be related to purchase intent. Information programs and economic incentives can operate to affect that perception.

54294 Solar energy: Hawaii and the US islands of the Pacific. Honolulu, HI; Department of Planning and Economic Development (1978). 121p. (NP—23941).

The current status of solar commercialization in Hawaii, Guam, American Samoa, the Trust Territory of the Pacific Islands, and the Commonwealth of the Northern Mariana Islands is outlined. Available solar resources are identified, and suitable applications suggested. Many barriers to solar commercialization exist in the Pacific. Chief among them are the initial expense of a solar installation, and the lack of information and public awareness regarding solar energy's potential. General public education and professional training programs are urgently needed, and information on solar resources and applications must be made available to consumers, the existing and potential solar industry, and policy makers. Other barriers to solar commercialization are also identified.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 54421, 54483, 55021, 55023, 55294

54295 (CONF-781191—) **Proceedings of the US DOE Photovoltaics Technology Development and Applications Program Review.** (OAO Corp., Beltsville, MD (USA)). 1978. Contract NAS-7-100-689604. 543p. Dep. NTIS, PC A23/MF A01.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The proceedings include summaries of thirty-eight presentations under the following sections: overview and project status reports; standards performance criteria; cost/economics; concentrator and flat panel technology alternative for 50 cents/watt; balance of system technology; and experience gained from the design and operation of photovoltaic systems.

54296 (CONF-781191—, pp 1.1-1.15) **Photovoltaic mission analysis.** Leonard, S.L. (Aerospace Corp., El Segundo, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The results of a computer simulation of performance and economics of photovoltaic systems in various applications is presented. This work was performed in support of the planning, development, and guidance of the national photovoltaic program. Photovoltaic applications likely to have a major energy impact in the near future are identified and evaluated. Strategies for stimulating the growth and early penetration of photovoltaic markets are discussed.

54297 (CONF-781191—, pp 1.16-1.21) **Planning and analysis for development of photovoltaic energy conversion systems.** Tabors, R.D. (Massachusetts Inst. of Tech., Cambridge). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

A demand and decision analysis for residential and utility photovoltaic systems is given. A comparison of Sun Day, Boston with the Nebraska State Fair showed that attitudes toward PV were not significantly different in the two locations. Deployment strategies and standards and performance criteria for PV energy systems are discussed.

54298 (CONF-781191—, pp 1.22-1.91) **Summary of systems definition project activities.** Jones, G.J.; Biringer, K.L. (Sandia Labs., Albuquerque, NM). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The Systems Definition Project and Sandia Laboratories in support of the DOE National Photovoltaic Program has as its objective to provide design information and subsystem requirement definition to the overall program. This includes application analysis and conceptual design for the wide variety of systems, system tradeoff studies and engineering design for the more promising application types, and the identification of the technology status and requirements for major subsystems and components.

54299 (CONF-781191—, pp 1.122-1.131) **Low-Cost Solar Array Project. LSA engineering status.** Ross, R. (Jet Propulsion Lab., Pasadena, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The engineering activities of the Low-Cost Solar Array Project are outlined. Solar cell module structural optimization, design, and cost are considered. Environmental testing, including dirt adherence testing and the effects of soiling on module performance, is discussed.

54300 (CONF-781191—, pp 1.132-1.138) **Low-Cost Solar Array Project. Operations status: module procurement, test, and evaluation.** Dumas, L. (Jet Propulsion Lab., Pasadena, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The production schedule and utilization of five different manufacturer's Block III solar array modules is reported. Results of qualification-type tests and the problem/failure report status are also summarized.

54301 (CONF-781191—, pp 1.139-1.165) **Status of the DOE Photovoltaic Concentrator Development Project.** Schueler, D.G. (Sandia Labs., Albuquerque, NM). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The overall objective of this project is to develop photovoltaic concentrator technology resulting in low-cost, long-life photovoltaic arrays at a price of less than $0.50 per peak watt by 1986. This is to be done by replacing costly solar cell area with lower cost reflective or refractive materials. A major mile stone schedule for photovoltaic concentrator development through 1986 is presented. Progress in the development of high conversion efficiency solar cells for operation in concentrated sunlight and a number of prototype concentrator arrays in the 100-1000 peak watt range are discussed.

54302 (CONF-781191—, pp 1.166-1.179) **Department of Energy Photovoltaic Tests and Applications Project.** Cull, R.; Ratajczak, T. (Lewis Research Center, Cleveland, OH). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The status of the NASA-LERC/DOE Photovoltaics Tests and Applications Project is reported. Information about several solar projects installed between April and October 1978 is tabulated. A block diagram is given for the Schuchuli Village power system and photovoltaic array field, and the power project status is summarized. There is a brief discussion of opportunities for photovoltiac systems in rural Africa. The effect of various cleaning agents on power recovery is presented. PV system regulators are discussed.

54303 (CONF-781191—, pp 1.180-1.194) **Solar Photovoltaic Field Tests and Applications Project.** Matlin, R. (Massachusetts Inst. of Tech., Lexington). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

Recent progress in the field testing of photovoltaic power systems is discussed. Detailed discussions are presented for selected field test experiments, including the 100 kW peak load center at Natural Bridge National Monument, a 15 kW peak daytime only AM radio station project a 15 kW peak agricultural site in Nebraska, and the 25 kW peak residential test facility of the Lincoln Laboratory.

54304 (CONF-781191—, pp 1.195-1.209) **Military applications of photovoltaic systems.** Faehn, D.D. (US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

A number of applications of photovoltaic systems designed for installation at military facilities under the sponsorship of Defense and DOE agencies is discussed. Two significant applications of solar cell power at the remote field testing facilities at Dugway, Utah and Yuma, Arizona are considered in detail. At Dugway Proving Ground, a remote, unmanned meteorological data station will be powered by a solar cell system rated at 4500 peak watts. Another power system is being developed for Yuma Proving Ground which could have widespread application throughout the military testing community. This will be a general purpose, mobile photovoltaic power system rated at 1000 peak watts. Applications for a fork lift truck battery charger and voice/data repeater are also considered.

54305 (CONF-781191—, pp 1.210-1.223) **Photovoltaic research and development status.** Feucht, D.L. (SERI, Golden, CO). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

An overview of the photovoltaic R and D program directed by the Solar Energy Research Institute is presented. The goals of this programs are 1) to develop thin film semiconductor and novel photovoltaic conversion concepts and 2) to demonstrate the feasibility of producing these cells for $100 to $300 per peak kW electric output by FY 1985. A listing of advanced materials and cell research is presented. High risk research is being pursued on amorphous materials, advanced concentrator cells and concepts, and electrochemical photovoltaic cells. An outline of the Innovative Concepts Program, which will be initiated during FY79, is given.

54306 (CONF-781191—, pp 1.224-1.254) **Photovoltaics and environmental impact considerations.** Weber, E.R. (Arizona Public Service Co., Phoenix). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

An overview is given of the proposed Airport Solar Photovoltaic Concentrator Project (ASPCP). The scope of the evaluation follows the Council on Environmental Quality Guidelines on Preparation of Environmental Impact Statements. Problems of electromagnetic interference, eye hazard and distractive glint were evaluated. To analyze the environment affected and the potential environmental impacts to both the site and potential facility, the factors of geology, soils, biology, archaeology, land use/zoning, waste disposal, air, radio service interference and eye hazards were evaluated conclusions and recommended actions are presented that pertain to the initiation of construction of the proposed 500 kW peak capacity solar photovoltaic concentrator system.

54307 (CONF-781191—, pp 1.268-1.283) **Chacteristics of a typical village in the solar belt of the developing countries of Asia, Africa, and Latin America.** Usmani, I.H. (United Nations, New York, NY). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

A vast majority of Third World Villagers are burdened by eternal poverty due, in a large part, to the energy vacuum in which they live. Many of these villages are located in the solar belt where the sun shines for more than 2500 hours in a year and where agriculture and animal wastes are universally available for anaerobic conversion into biogas (methane) and where strong winds and micro-hydro power potential can be tapped. Panels of PV cells can be used for rural electrification and energy stored in lead acid battery accumulators. The social and economic effects of rural electrification are discussed and work under U.N. auspices is mentioned. Financing for ural electrification through a concentrated international effort is suggested. Finally, there is a need to break the prohibitive price barrier of PV cells.

54308 (CONF-781191—, pp 2.2-2.15) **Photovoltaic performance criteria and test standards project summary.** Nuss, G.R. (SERI, Golden, CO). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The objectives, status, and plans of the quality assurance element of the National Photovoltaic Program Plan are summarized. The broad scope of the project is aimed at the development and use of performance criteria and test methodologies which will contribute to the development and use of photovoltaic energy conversion systems. The development of laboratory accreditation and certification programs for photovoltaics and the validation of test methodologies is discussed. An ongoing attempt is made to integrate PV quality assurance with other PV, standard and code activities.

54309 (CONF-781191—, pp 2.16-2.20) **Purpose and role of product standards in the commercialization of new energy technologies: a preliminary analysis.** Bottaro, D.J. (Massachusetts Inst. of Tech., Cambridge). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The purpose of standards activities in the National Photovoltaics Program is to produce those socially beneficial effects, produced better by standards than by other alternatives. The need for standards, which arise from practical problems in the operation of markets, is discussed. The influence of standards upon the industry to which they apply are discussed in terms of their effect on the product's cost, the demand for the product, and the competitive nature of the standardized product's industry. In the context of commercialization, governmental efforts should be to encourage desirable standards which would not be otherwise fothcoming in a timely fashion.

54310 (CONF-781191—, pp 2.21-2.28) **Voluntary consensus standards system and the plan for quality assurance and standards for photovoltaics.** Riley, J.D. (SERI, Golden, CO). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The voluntary consensus standards system is the traditional framework used in this country to develop standards. Standards provide a common language between all members of a concerned technology community and are developed by all members of this group through the operation of due process. The application of due process to the adoption of standards is discussed. It is noted that building code provisions will have to be revised to accomodate photovoltaics, and standards for health and safety characteristics of PV systems will have to be developed. Product/system certification as a measure of performance, reliability, and safety is also considered.

54311 (CONF-781191—, pp 2.29-2.37) **Photovoltaics subsystems.** Hoffman, A.; Ross, R. (Jet Propulsion Lab., Pasadena, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

An overview is given of significant items that were discussed: criteria, test methodology, and standards priorities for each photovoltaic array element with respect to performance, reliability, durability, safety, environmental hazards, and nomenclature.

54312 (CONF-781191—, pp 2.38-2.51) **Performance criteria for photovoltaic power conditioning, control, and storage.** Schafft, H.A. (National Bureau of Standards, Washington, DC). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

Initial indentification of performance criteria for power conditioning, control, cabling and storage in photovoltaic systems were made. The relationship of the power conditioning subsystem, which includes those elements which handle the exchange of power between the PV array, utility, load and storage, and the monitoring and control system is discussed. A list of performance characteristics for the power subsystem relevant to its interfaces with the other part of the PV system was developed and problem areas were identified. Performance characteristics were also developed and discussed for the monitoring and control subsystems. Storage types for the PV systems were identified and the immediate need for the development of performance criteria for batteries was cited.

54313 (CONF-781191—, pp 2.52-2.67) **Photovoltaic energy systems safety standards development.** DeBlasio, R. (SERI, Golden, CO). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The guidelines established by the Photovoltaics Subcommittee on Safety, as well as recommendations provided by the Coordinating Council and the Task Group Steerng Committee regarding photovoltaic safety are reported. Common safety hazards that may be encountered at the systems level were identified. The sequence for developing safety criteria and criteria verification techniques was discussed. Generic areas for safety concerns are identified.

54314 (CONF-781191—, pp 2.96-2.104) **Analysis methodology: on-site photovoltaic system applications.** Siegel, B. (Aerospace Corp., El Segundo, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

An Analysis flow chart for photovoltaic total energy systems (PTES) for residential applications is presented. The levelized annual cost of energy for a 50 kWh thermal storage system is computed as a function of the area of a combined photovoltaic thermal panel. Sensitivity to the effects of changes in system cost assumptions is discussed. The minimum levelized annual cost of service for single-family residential applications for several system arrays is given.

54315 (CONF-781191—, pp 2.122-2.129) **Penetration modeling for near and intermediate term photovoltaic applications.** Merrill, O.H. (Science Application, Inc., McLean, VA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

A model for developing a range of market penetration estimates for present and intermediate term photovoltaic products is presented. Model outputs include PV demand by application, PV system prices, and PV business volume. Assumptions underlying the model are outlined. Preliminary results of a study of the export

potential of photovoltaics are presented. Sources of uncertainties and problems in the model are outlined.

54316 (CONF-781191—, pp 2.164-2.193) **Design alternatives for cost effective solar arrays.** Ross, R.G. (Jet Propulsion Lab., Pasadena, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

A framework for array cost comparisons is presented. A cost breakdown for typical flat-plate arrays is given and progress toward $0.50/watt flat-plate modules is discussed. An overview and status are given for the large area silicon sheet task and the encapsulation task.

54317 (CONF-781191—, pp 2.212-2.219) **Experience gained from the design and operation of photovoltaic systems.** Pope, M.D. (Massachusetts Inst. of Tech., Lexington). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

Experience gained to date on PV power systems, including both experience gained from designing systems which have not yet been constructed as well as operating experience from deployed systems, is discussed. Flat plate and concentrator systems were considered. Results of discussions about large and small PV flat plate systems, concentrator systems (e.g., the Mississippi County Community College Project), PV systems control, battery storage and inverters are summarized.

54318 (CONF-781191—, pp 1.255-1.267) **EPRI photovoltaics program overview.** DeMeo, E.A. (Electric Power Research Inst., Palo Alto, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

54319 (COO—4094-33) **Design optimization and performance characteristics of a photovoltaic microirrigation system for use in developing countries.** Matlin, R.W. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 10 Jul 1979. Contract EY-76-C-02-4094. 66p. Dep. NTIS, PC A04/MF A01.

Tens of millions of the world's poorest farmers currently subsist on small farms below two hectares in size. The increasing cost of animal irrigation coupled with decreasing farm size and the lack of a utility grid or acceptable alternate power sources is causing interest in the use of solar photovoltaics for these very small (subkilowatt) water pumping systems. The attractive combinations of system components (array, pump, motor, storage and controls) have been identified and their interactions characterized in order to optimize overall system efficiency. Computer simulations as well as component tests were made of systems utilizing flat-plate and low-concentration arrays, direct-coupled and electronic-impedance-matching controls, fixed and incremental (once or twice a day) tracking, dc and ac motors, and positive-displacement, centrifugal and vertical turbine pumps. The results of these analyses and tests are presented, including water volume pumped as a function of time of day and year, for the locations of Orissa, India and Cairo, Egypt. Finally, a description and operational data are given for a prototype unit that was developed as a result of the previous analyses and tests.

54320 (COO—4094-42) **Physical and electrical degradation of photovoltaic modules after exposure in terrestrial environments.** Forman, S.E.; Themelis, M.P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 5p. (CONF-790803—40). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Between March 1977 and March 1979, MIT/Lincoln Laboratory, in conjunction with the US Department of Energy, placed 75 kW of photovoltaic modules at various experimental test sites in the United States. The largest of these include a 25 kW array field in Mead, Nebraska, used to power corn irrigation and crop drying equipment; a ground level 25 kW array field in Lexington, used as a residential system test bed; a 15 kW rooftop test bed in Lexington, used to evaluate components of photovoltaic systems prior to field installation. To date only 44 modules (amounting to 600 watts) out of 6,000 have experienced electrical failures. This report summarizes the performance of the photovoltaic modules at the Mead test site and describes the physical and electrical changes which have occurred due to weathering and soil accumulation since start-up in July 1977. Where relevant, comparisons will be made with modules at the other test sites.

54321 (COO—4094-43) **Performance of the Mead, Nebraska, 25 kWp photovoltaic solar energy system and comparison with simulation.** Bucciarelli, L.L.; Hopkinson, R.F. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 6p. (CONF-790803—41). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

A photovoltaic solar energy system has been providing power for irrigation and crop drying at an agricultural field station of the University of Nebraska. The system, developed and maintained jointly by MIT/Lincoln Laboratory and the University and under contract to the US Department of Energy, consists of a 25 kWp PV array, a battery subsystem, an inverter, a controller, and a data collection and management system. Field data indicate that the PV array performs up to expectations if allowance is made for degradation. The array operates at an efficiency (based on cell area) of between 7 and 8%; the battery subsystem at an in-out efficiency of 83%, and the inverter at 87%. During the irrigation season the system delivers 70% of the energy provided by the PV array to the pump motor. Approximately 10% of the array energy is wasted when the battery is in a fully charged state and the array power exceeds the load. Performance of the system was compared with the results of a computer simulation. This comparison showed agreement to within +- 5% on daily energy totals for array output, inverter input, battery input and output.

54322 (COO—4094-45) **Field tests of PV power systems.** Bucciarelli, L.L.; Hopkinson, R.F.; Pope, M.D. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 5p. (CONF-790541—47). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Two of the eleven experimental PV systems which MIT/Lincoln Laboratory currently has underway for the US Department of Energy are discussed: the 25 kW agricultural PV test system at Mead, Nebraska, and the 15 kW PV power system for Radio Station WBNO at Bryan, Ohio. The radio station power system is under construction and turn-on is expected in late summer of 1979. The design of this system is of particular interest because it is intended to minimize balance of system costs, particularly in the areas of structure, foundations, site preparation and installation. The Nebraska system has been in operation for nearly two years and has provided valuable information on system and subsystem performance and reliability which is presented herein. It also has been extensively modeled. Comparisons of predicted and observed performance are reported below. Areas requiring further study in order to improve presently available PV system modeling techniques are identified.

54323 (COO—4094-49) **PV-powered microirrigation systems.** Matlin, R.W. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 5p. (CONF-790541—48). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Tens of millions of farmers currently subsist on small farms below two hectares in size. The increasing cost of animal irrigation coupled with decreasing farm size and the lack of a utility grid or acceptable alternate power sources is causing interest in the use of solar photovoltaic for these very small (subkilowatt) water pumping systems. The attractive combinations of system components (array, pump, motor, storage, and controls) have been identified and their interactions characterized in order to optimize overall system efficiency. Computer simulations as well as component tests were made of systems utilizing flat plate and low concentration arrays, direct-coupled and electronic impedance matching controls, fixed and incremental (once or twice a day) tracking, dc and ac motors, and positive displacement, centrifugal and verticle turbine pumps. The results of these analyses and tests are presented for Orissa, India and Cairo, Egypt, and include water volume pumped as a function of time of day and year. Finally, a description and operational data is given for the prototype unit that was developed as a result of the previous analyses and tests.

54324 (COO—4094-55) **Solar Photovoltaic Project: materials, processes, and testing activities. Quarterly report, 1 January-31 March 1979.** Forman, S.E.; Themelis, M.P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Jun 1979. Contract EY-76-C-02-4094. 50p. Dep. NTIS, PC A03/MF A01.

The Department of Energy has set a 20-year-lifetime goal for terrestrial photovoltaic modules. Massachusetts Institute of Technology's Lincoln Laboratory, in its capacity as a Photovoltaic Field Tests and Applications Center, has established throughout the United States various experimental test sites which range in size from 0.1 to 25 kW of peak power. These sites include modules from several manufacturers and serve as test beds for photovoltaic system components. The activities of the Materials, Processes, and Testing Laboratory of the Solar Photovoltaic Project during a three-month (1/1/79-3/31/79) period are summarized. During this period, an inspection trip was made to the Mead, Nebraska, test site. The modules were tested in the field to determine the extent of physical and electrical degradation which had taken place since previous inspections. In addition, several modules were removed from the site for more detailed laboratory examination. The results of both the field testing and laboratory analyses are reported.

54325 (DOE/ET/23003—1) **Emerging material systems for solar cell applications.** Biter, W.J.; Szedon, J.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 8 Aug 1979. Contract AC04-79ET23003. 23p. Dep. NTIS, PC A02/MF A01.

Primary effort to date involves modifications and additions to the vacuum system in order to produce films of InP by the plasma-induced deposition process.

54326 (DOE/ET/23103—5) **Carrier transport through heterojunction solar cells.** Boeer, K.W. (Delaware Univ., Newark (USA); SES, Inc., Newark, DE (USA)). 1979. Contract EX-76-C-23-1030. 7p. (CONF-790457—8). Dep. NTIS, PC A02/MF A01.

From 1979 photovaltaic solar energy conference; West Berlin, F.R. Germany (23 Apr 1979).

The carrier transport through heterojunctions is influenced by the interconnection between the bands of the two semiconductors, by space charge effects near this interconnection and by interface recombination. The estimation of the discontinuity of the conduction bands using the difference in electron affinities is insufficient. A modified model takes the chemical and crystallographical nature of the interconnection into consideration. The analysis includes the discussion of a space charge double layer caused by charged dangling bonds along the dislocation network and its compensation via charged defects. These cause a certain donor-acceptor pair formation which act as efficient recombination centers and cause a reduction of the open circuit voltage. The space charge double layer and interface recombination may cause a non-monotonic band profile near the interface. The specifics of such band profile for CdS/Cu_2S and Cd/sub x/Zn/sub 1-x/S/Cu_2S heterojunctions are evaluated quantitatively and agree within the experimental error with the observation, that, with decreasing lattice mismatch, the open circuit voltage increases, while the short circuit current decreases.

54327 (DOE/ET/23103—6) **Photovoltaic effect, its present understanding and remaining mysteries.** Boeer, K.W. (Delaware Univ., Newark (USA); SES, Inc., Newark, DE (USA)). 1979. Contract EX-76-C-23-1030. 5p. (CONF-790541—44). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The present phenomenological understanding of the photovoltaic effect and solar cells is discussed. Unexplained questions and problems with the effects of various device parameters on the current-voltage characteristics are discussed, and the need for more sophisticated theoretical analyses of photovoltaic cells is stressed. 26 references. (WHK)

54328 (DOE/JPL—1012-79/5(Vol.2)) **Normative price for a manufactured product: the SAMICS methodology. Volume II. Analysis. JPL publication 78-98.** Chamberlain, R.G. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jan 1979. Contract EX-76-A-29-1012. 95p. Dep. NTIS, PC A05/MF A01.

The Solar Array Manufacturing Industry Costing Standards (SAMICS) provide standard formats, data, assumptions, and procedures for determining the price a hypothetical solar array manufacturer would have to be able to obtain in the market to realize a specified after-tax rate of return on equity for a specified level of production. This document presents the methodology and its theoretical background. It is contended that the model is sufficiently general to be used in any production-line manufacturing environment. Implementation of this methodology by the Solar Array Manufacturing Industry Simulation computer program (SAMIS III, Release 1) is discussed.

54329 (DOE/JPL/1012—78/1(Vol.1)) **Historical evidence of importance to the industrialization of flat-plate silicon photovoltaic systems: executive summary.** Smith, J.L.; Gates, W.R.; Lee, T. (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1978. Contract EX-76-A-29-1012. 16p. (JPL-PUB—78-36(Vol.1)). Dep. NTIS, PC A02/MF A01.

The results of a study which analyzes the Low Cost Silicon Solar Array Project (LSSA) plans with respect to the industrialization of new production technologies expected to be forthcoming as a result of the project's technology development efforts. In particular, LSSA's mandate to insure an annual production capability of 500 MWp for the photovoltaic supply industry by 1986 is critically examined. Conclusions from the analysis are utilized in a discussion of LSSA's industrialization plans, particularly the plans for pilot, demonstration, and commercial scale production plants. Specific recommendations for the implementation of an industrialization task and the disposition of the project quantity goal are derived.

54330 (DOE/JPL/954728—2) **Ion plating of solar cell arrays. Final report, March 12, 1977-December 31, 1978.** Finegan, B.M. (Endurex Corp., Dallas, TX (USA)). 1978. Contract NAS-7-100-95-4728. 23p. Dep. NTIS, PC A02/MF A01.

Endurex has been engaged in a feasibility study to determine practicality of utilizing Endurex ion plated films to serve as anti-reflective and/or protective encapsulants for solar cell arrays. It has been demonstrated that thin films of oxide materials between 1000 and 2000 A thick will protect a photovoltaic device from degradation in salt spray. Additionally, transmissively data accumulated on Endurex coatings show that the anti-reflective (AR) properties of this film are equal to any achieved by more widely used processes. The Endurex ion plating process is capable of being scaled up to meet 1986 throughput goals at a cost which is in line with 1986 cost goals. An additional benefit that may be realized by the utilization of ion plating is that it is an effluent free process utilizing no wet chemistry.

54331 (DOE/TIC—10165) **Computer modelling of amorphous materials for photovoltaic conversion. Second quarterly progress report.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). 16 Apr 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

The results of exploraton of various aspects of electron localization in models of amorphous silicon are reported. These results have been obtained by computations on only one or two examples, but nevertheless are useful in providing a concrete picture of a-Si that has some unexpected features. Among these are fluctuations in charge neutrality as large as 0.5e, which have implications for the electrical conductivity of a-Si as well as its vibration frequencies and infrared absorption coefficient. Also, when defects in a-Si are introduced, it is found that the localization parameter reaches remarkably high values for a few states at the Fermi level.

54332 (ORO—5134-1) **Studies of basic mechanisms influencing solar-cell efficiency for terrestrial applications.** (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). 1978. Contract EY-76-S-05-5134. 54p. Dep. NTIS, PC A04/MF A01.

The research activities include determination of the basic mechanisms that control and limit solar-cell efficiency, engineering design of solar cells, and the improvement of cell design to increase the power conversion efficiency and to define the maximum efficiency expected from a given material technology. Experimental methods for determining the basic mechanisms in the highly-doped emitter region and for determining diffusion length and lifetime in the base region of p-n junction solar cells are discussed. The evolution of three different silicon solar cell structures proposed to yield efficiencies greater than 20% for illumination levels in the 25 to 100 sun range is discussed.

54333 (SAND—79-7006) **Low-cost structures for photovoltaic arrays. Final report.** Masser, P. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). Aug 1979. Contract EY-76-C-04-0789. 204p. Dep. NTIS, PC A10/MF A01.

Designs of photovoltaic array support structures, which encourage life cycle cost reduction through mass production techniques, material cost reduction, and simplified installation methods, are presented. Non tracking collectors with a low concentration ratio (one to about two suns) are considered primarily for commercial and utility applications. The results are applicable to both thermal and photovoltaic flat plate collectors. A value analysis approach was used, starting with a survey of the current state-of-the-art which found an absence of pertinent references on array support structures. Also, realistic load criteria were not found, and this was determined to be a key area for future cost reduction. Heights above the ground, array geometry, and wind direction all have important effects on loads. Foundation design was also found to be a key area for future cost reduction. A generic concept study was conducted, aimed at life cycle cost reduction, and representative examples were chosen. Then computerized parametric cost estimates were obtained for truss and frame supports. Next, construction cost tables were used for truss, frame, gunnite, concrete slab, reflector and inflatable configurations. With a production volume corresponding to 1986 DOE goals, typical costs are from 10 to 25 dollars (1975) per square meter. Estimates of the annual raw material (metal, wood, concrete, etc.) requirements were made using year 1986 and year 2000 DOE production goals, and found to range from much less than one percent (steel truss in 1986) to over 100% (aluminum reflector .060 inches thick in year 2000) of current U.S. production rates for the various materials and configurations.

54334 (SERI/TP—49-185) **Photovoltaic material & device measurements workshop: focus on polycrystalline thin film cells.** (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 190p. (CONF-790601—). Dep. NTIS, PC A09/MF A01.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The general purpose of the workshop was to accelerate the development of thin film solar cells by improving the versatility and reliability of material and device measurement techniques. Papers were presented under the following sessions: structural/chemical session; optical/electro-optical session; charge transport session; and poster session. Each paper was processed for EDB.

54335 (SERI/TP—49-185, pp 5-9) **Perspective on photovoltaic material and device measurements.** Rothwarf, A. (Univ. of Delaware, Newark). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The distinct stages in the development of polycrystalline thin film solar cells are reviewed. Detailed discussions are presented for the conceptual stage, the cell design stage, prototype device development, and an optimization stage. Durability and failure testing and large scale production technology are discussed.

54336 (SERI/TP—49-185, pp 11-14) **Structural and chemical characterization of photovoltaic materials and devices.** Meakin, J.D. (Univ. of Delaware, Newark). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

A brief review of the factors involved in understanding the structure and operation of a thin film solar cell is given. Discussion of the techniques for measuring the morphological, crystallographic and defect structure of solar cell components is presented. Techniques for analyzing the chemical composition of solar cells are considered.

54337 (SERI/TP—49-185, pp 21-24) **EBIC characterization of polycrystalline silicon solar cells.** Hanoka, J.I. (Mobil Tyco Solar Energy Corp., Waltham, MA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The potentialities and limitations of the Electron Beam Induced Current (EBIC) mode of the scanning electron microscope for polycrystalline silicon solar cells are discussed. Quantitative studies and representative results on EFG ribbon silicon solar cells and refined metallurgical silicon solar cells are presented and compared.

54338 (SERI/TP—49-185, pp 27-30) **Backscattering and TEM studies of layered structures.** Mayer, J.W. (California Inst. of Tech., Pasadena). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Two analytical tools, Rutherford backscattering spectrometry (RBS) and transmission electron microscopy (TEM), which have been utilized in the measurement of thin film and layered structures are reviewed. The techniques are illustrated by choosing examples of solid-phase epitaxial growth of silicon through Pd silicide as a transport medium. Backscattering and channeling spectra and TEM micrographs of epitaxial layers are shown.

54339 (SERI/TP—49-185, pp 35-38) **New techniques for the study and control of grain boundary effects.** Wood, R.F; Young, R.T.; Westbrook, R.D.; Narayan, J.; Christie, W.H.; Cleland, J.W. (Oak Ridge National Lab., TN). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Several recently developed doping techniques are discussed which should allow the problems of grain boundary segregation and diffusion to be studied and circumvented if desired. These techniques involve transmutation doping and laser-induced melting of the near-surface region of the polycrystalline samples.

54340 (SERI/TP—49-185, pp 41-44) **Grain size and its influence on efficiency in polycrystalline GaAs solar cells.** Blakeslee, A.E.; Vernon, S.M. (IBM Research Center, Yorktown Heights, NY). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Several different processes for growing polycrystalline GaAs thin films are described. The correlation between the various processes and the resulting grain sizes and solar cell parameters are examined. A series of GaAs thin films are produced, covering a factor of several hundred in grain size, which should be useful to test the theories relating grain size to cell parameters. It is concluded that the cell efficiencies do not increase as expected when large increases are effected in the grain size.

54341 (SERI/TP—49-185, pp 47-50) **Characterization of EFG silicon ribbons by ion beam techniques.** Hage-Ali, M.; Stuck, R.; Toulemonde, M.; Siffert, P. (Centre de Recherches Nucleaires, Strasbourg, France). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Secondary Ion Mass Sepctrometry (SIMS) combined with Rutherford Backscattering (RBS) and specific nuclear reactions have been used to investigate the nature, concentration, and distribution of the impurities existing in EFG silicon ribbons grown from the melt with a graphite die. The relative features of these methods are discussed.

54342 (SERI/TP—49-185, pp 53-56) **Composition analysis of Cu_2S(Zn,Cd)S thin film solar cells by means of electron spectroscopy.** Burton, L.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Dwight, D.W.; Zeller, M.V. 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The composition of copper sulfides as formed on zinc or cadmium sulfide via ion-exchange is studied. Three types of electron beam analyses were performed to elucidate composition profiles for these junctions. It is found that the Zn and Cd profiles are distinctly different through the outer structure. The results indicate that doubly charged zinc ions diffuse out more slowly during the ion-exchange reaction.

54343 (SERI/TP—49-185, pp 59-62) **Scanning light spot analysis of faulty solar cells.** Lehovec, K.; Fedotowsky, A. (Univ. of Southern California, Los Angeles). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Current output patterns for solar cell panels exposed to a scanning light spot are computed on the basis of a distributed network model. Patterns of fault-free panels are compared with those of faulty cells having either cracks which expose the junction and cause leakage current, or else point shorts in series with spreading resistances. The computed data can be used to evaluate previously obtained experimental results.

54344 (SERI/TP—49-185, pp 65-68) **Photoconductivity as a probe of polycrystalline films.** Bube, R.H. (Stanford Univ., CA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The use of photoexcitation to change the conductivity of polycrystalline films and thus provide information about the properties of the films is reviewed. The spectral response and temperature dependence of photoconductivity and photoconducivity decay, as well as photoinduced chemisorption phenomena, are considered. The relative contributions from density and mobility changes to the conductivity change induced by photoexcitation are discussed for CdS and PbS films.

54345 (SERI/TP—49-185, pp 71-73) **Optical properties of polycrystalline semiconductor films.** Clark, A.H. (Univ. of Maine, Orono). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Techniques for the determination of optical constants of polycrystalline semiconductor films important for photovoltaic applications are reviewed. Artifacts produced by surface roughness are discussed. The principle features of the optical constants of ideal single crystal semi conductors are reviewed and used as a basis for dicussing effects due to grain boundaries. Two models of grain boundary effects - amorphous and single crystal mixtures, and electric field broadening of the absorption edge - are discussed.

54346 (SERI/TP—49-185, pp 75-78) **Electron diffusion lengths in the CU/sub x/S/CdS cell from spectral response measurements.** Moses, C. (State Univ. of New York, Canton); Wasserman, D. 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The recombination diffusion length of electrons in Cu/sub x/S generated by light in standard wet-dip Cu/sub x/S - CdS solar cells is determined from measurements of the relative variation in short circuit current with wavelength. For cells with a copper sulfide thickness of .2 μ to .3 μ, diffusion lengths ranged from .08 to .26 μ. No significant changes in diffusion length were measured after various cell heat treatments in air and hydrogen even when large changes in the short circuit current occured.

54347 (SERI/TP—49-185, pp 81-83) **Design and utilization of a microprocessor-controlled absolute spectral response system.** Kilgren, L.M.; Wyeth, N.C.; Devaney, W.E. (Univ. of Delaware, Newark). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

A fully automated system is described which permits the direct monitoring of solar cell output under varying conditions of illumination and bias voltage. The primary system components are a chopped monochromatic light source of continuously variable wavelength, a lock-in amplifier, and a microprocessor. Analogue-to-digital and digital-to-analogue conversion allows the microprocessor to be used to control data acquisition and to perform data conditioning and output.

54348 (SERI/TP—49-185, pp 85-87) **Effective diffusion length in polycrystalline.** Chu, T.L.; Stokes, E.D.; Chu, S.S. (Southern Methodist Univ., Dallas, TX). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

A brief review of the mechanisms which determine the minority carrier diffusion length in semiconductors is presented. Two

methods for the measurement of the effective diffusion length in polycrystalline films of significant photovoltaic materials are reviewed: the surface photovoltage method for silicon films and the scanned electron beam method for gallium arsenide films.

54349 (SERI/TP—49-185, pp 89-92) **EBIC and scanning light spot technique for investigating the response of polycrystalline solar cells.** Inoue, N.; Goodnick, S.M.; Wilmsen, C.W. (Colorado State Univ., Fort Collins). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The resolution of the electron beam induced current (EBIC) and scanning light spot (SLS) techniques in the investigation of photoresponse variations in polycrystalline silicon solar cells is discussed. Comparision of the results obtained by the two techniques is reported. Observations of grain boundaries and defects seen by EBIC are presented.

54350 (SERI/TP—49-185, pp 95-98) **Some investigations on the influence of defects/grain boundaries on photovoltaic mechanisms in poly-crystalline silicon films.** Sopori, B.L.; Baghdadi, A. (Motorola, Inc., Phoenix, AZ). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The results of a continuing study of the influence of defects and grain boundaries on the local value of the diffusion length L are described. Relationships between local values of L and the local photoresponse are considered. A definition and measurement of an average value for L in a polycrystalline cell which can be well related to solar cell characteristics is discussed. Several nondestructive methods used to measure local parameters like L, carrier lifetime and photoresponse are described.

54351 (SERI/TP—49-185, pp 101-104) **Scanned laser response studies of current transport in polycrystalline Czochralski and dendritic web silicon MIS solar cells.** Szedon, J.R.; Temofonte, T.A.; O'Keeffe, T.W. (Westinghouse Research and Development Center, Pittsburgh, PA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The research program to investigate MIS solar cells on silicon material of good basic quality encompassing a range of grain sizes and distributions is discussed. Studies using scanned laser spot photocurrent response to determine the electrical activity of grain boundaries are reported.

54352 (SERI/TP—49-185, pp 107-109) **Infrared electroluminescence as a diagnostic tool for polycrystalline GaAs solar cells.** Turner, G.W.; Fan, J.C.C.; Salerno, J.P. (Massachusetts Inst. of Tech., Lexington). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Experiments to extend the electroluminescence technique to the study of GaAs polycrystalline solar cells are discussed. It is found that as in the case of single-crystal cells, the intensity and uniformity of the electroluminescence from polycrystalline cells correlates with the photovoltaic response. The information that can be obtained by this method is listed and a typical photomicrograph is shown.

54353 (SERI/TP—49-185, pp 111-112) **Study of grain boundaries in GaAs by scanning light microscopy.** Fletcher, R.; Wagner, D.K.; Ballantyne, J.M. (Cornell Univ., Ithaca, NY). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The technique of scanning light microscopy (SLM) to investigate the electronic structure of grain boundaries in GaAs bicrystals prepared from unintentionally doped (n-type) polycrystalline source material is discussed. It is found that the grain boundaries are of two types: those with internal fields and those with none. Those specimens with internal fields exhibit a highly nonohmic current-voltage relation, whereas specimens with no internal fields behave ohmically. The structure of the photocurrent and photovoltage as a function of distance from the spot is discussed.

54354 (SERI/TP—49-185, pp 115-118) **Barrier heights and passivation of grain boundaries in polycrystalline silicon.** Seager, C.H.; Ginley, D.S. (Sandia Labs., Albuquerque, NM). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Experimental measurements of the zero-bias conductance G_0 and barrier capacitance C_0 for grain boundaries in an n-type semiconductor are reported. These measurements give information about the barrier height at the boundaries. The effects of current shunting via defects is mentioned and the bias dependence of grain boundary barrier conductance and capacitance is noted to yield further information about the electronic structure of grain boundaries. The effects of hydrogenation in silicon are discussed.

54355 (SERI/TP—49-185, pp 123-126) **Grain boundary resistance measurements in polycrystalline GaAs.** Cohen, M.J.; Harris, J.S. Jr.; Waldrop, J.R. (Rockwell International Science Center, Thousand Oaks, CA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Auger Electron Spectroscopy was used to perform the first measurements of the resistivity of a single grain boundary in polycrystalline GaAs. The results are discussed.

54356 (SERI/TP—49-185, pp 131-134) **Grain boundary effects and conduction mechanism studies in CR-MIS solar cells on polycrystalline silicon.** Anderson, W.A. (State Univ. of New York, Buffalo); Hyland, S.L.; Delahoy, A.C.; Rajkanan, K. 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Studies of photovoltaic processes in polycrystalline silicon to evaluate the use of this material as a potential low-cost replacement for single crystal silicon cells are discussed. Data on the photovoltaic and spectral response, laser scan studies, conduction mechanisms and surface states are considered. It is found that the effective diffusion length is limited by the silicon formation process and by grain boundaries. An increased interface state density is shown to decrease the open circuit voltage. Space charge limited conduction is observed.

54357 (SERI/TP—49-185, pp 137-140) **Study of spatial inhomogenieties in photosensitive materials using dc and microwave techniques.** Herczfeld, P.; Hanlon, L.; Wargin, J. (Drexel Univ., Philadelphia, PA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Measurements of spatial inhomogenieties of photoconductivity in CdS crystals, polycrystalline films and powders using dc and microwave techniques are reported. Marked differences are observed between the dc and the microwave results.

54358 (SERI/TP—49-185, pp 141-143) **Capacitance as a tool for investigating thin-film CdS/Cu_2S heterojunctions.** Manthey, W.J.; Wyeth, N.C. (Univ. of Delaware, Newark). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

A technique that has been developed to measure the capacitance of operational solar cells under varying conditions is described. A major advantage of this technique, which uses a lock-in amplifier to measure the susceptive component of an ac signal, is that the capacitance can be measured under actual operating conditions and capitalizes on the sensitivity of the capacitance to the intensity and spectral content of the illumination. Key physical properties of the heterojunction regions of a CdS/Cu_2S cell are elucidated using these measurements.

54359 (SERI/TP—49-185, pp 145-148) **Correlation of grain boundary electrical properties with grain boundary impurities in multigrained silicon using surface analytical techniques.** Kazmerski, L.L.; Ireland, P.J. (Solar Energy Research Inst., Golden, CO). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The applications of complementary surface analysis techniques - Auger electron spectroscopy and secondary ion mass spectroscopy - to the comparative compositional analysis of grain and grain boundary regions in multigrained silicon are presented. The method is used to provide the first direct physical evidence for the localization of impurities at the grain boundaries in silicon grown by the casting and directional solidification techniques.

54360 (SERI/TP—49-185, pp 151-153) **Diffusion length measurements in Cu_2S.** Biter, W.J.; O'Keeffe. (Westinghouse Research and Development Center, Pittsburgh, PA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Measurements of diffusion length and other electronic properties of thin Cu_2S layer obtained by a scanned laser beam technique are reported. Some initial results obtained with Cu_2S formed on CdS thin film are discussed. A change in the losses associated with the junction seemed to be the dominant change with heat treatment.

54361 (SERI/TP—49-185, pp 155-158) **Measurement of resistivity of thin CdS films on brass substrates.** Hogan, S. (Solar Energy Research Inst., Golden, CO); Wagner, S.; Barnes, F. 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

A nondestructive resistivity measurement technique for thin semiconductor films deposited on metallic substrates is reported. The technique involves determining the sample resistivity by a field perturbation analysis on a semi-confocal Fabry-Perot resonator.

54362 (SERI/TP—49-185, pp 161) **Ellipsometry of thin silicon dioxide films on rough polycrystalline silicon surface.** Burleigh,

T.D.;Wagner, S.; Ciszek, T.F. (Solar Energy Research Inst., Golden, CO). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

54363 (SERI/TP—49-185, pp 163-166) **Experimental determination of the photon economy in polycrystalline thin film photovoltaic materials and devices.** Bragagnolo, J.A.; Fagen, E.A. (Univ. of Delaware, Newark). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

The techniques of optical measurement and analysis of the photon economy of a photovoltaic device are described. The power and utility of this technique are illustrated by its application to two problems: (1) the determination of the intrinsic absorption edge of polycrystalline thin films of Zn_3P_2, and (2) analysis of photon collection efficiency of polycrystalline CdS/Cu_2S cells.

54364 (SERI/TP—49-185, pp 171-173) **Etching of CdS films and its effect on the morphology of the Cu_2S layer of CdS thin film solar cells.** Shirland, F.A. (Westinghouse Research and Development Center, Pittsburgh, PA). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Results of a study of the morphology of the Cu_2S layer of CdS thin film solar cells subjected to a strong HCl etch are reported. It is shown that one of the results of the HCl pre-etch is the formation of etch pits in the CdS films, and that the Cu_2S layer which is subsequently formed penetrates into CdS grain boundaries from the side walls of the etch pits as well as from the upper surface of the film. Preliminary results are presented on the effect of different etchant concentrations, temperatures and times on the formation of etch pits and on the texturing of variously processed CdS films.

54365 (SERI/TP—49-185, pp 175-178) **Effect of substrate orientation on the properties of the PbS-Si heterojunciton.** Elabd, H.; Steckl, A.J.; Vidinski, W. (Rensselaer Polytechnic Inst., Troy, NY). 1979.

From Photovoltarc material and device measurement workshop; Arlington, VA, USA (11 Jun 1979).

Lead sulfide-silicon heterostructures were studied by electron microscopy, x-ray diffraction and analysis and Auger electron spectroscopy. Thin PbS films were deposited on Si substrates with (100) and (111) orientation. The as-grown Pbs has been found to consist of a uniform polycrystalline film and chain-like clusters. The PbS grain sizes and crystallite orientation were compared for the two substrates, and the presence of foreign atoms at the PbS-Si interface was detected.

54366 Synchronizing mechanism for the unfolding of carrier elements for solar cells. Chenin, C.; Vermalle, J.A. (to Societe Nationale Industrielle Aerospatiale). US Patent 4,148,163. 10 Apr 1979. Priority date 18 Jun 1976, France, 6p.

The synchronizing mechanism for the unfolding of articulated carrier elements which are outwardly extendable or inwardly retractable in a bellows-type arrangement on each side of a satellite body comprises a system of gear-train units placed alternately at one end of a driving carrier element. The mechanism is adapted to cooperate with at least one drive motor for folding-back or unfolding the carrier elements.

54367 Solar photoelectric module. Litsenko, T.A.; Potapov, V.N.; Strebkov, D.S. US Patent 4,146,407. 27 Mar 1979. Filed date 15 Dec 1977. 8p.

A solar photoelectric module is disclosed, wherein the solar energy concentrator also performs the function of a cooling means for the photovoltaic solar energy converter. With that object in view the concentrator is made as a hollow hermetically sealed vessel filled with a transparent heat transfer agent, while the photovoltaic solar energy converter is placed inside the hollow vessel.

54368 Solar collector using total internal reflectance. Johnson, G.R.; Miles, M.G.; Salyer, I.O.; Hardy, E.E. (to Monsanto Co.). US Patent 4,143,234. 6 Mar 1979. Filed date 8 Nov 1976. 6p.

A solar collector is constructed of a photoelectric cell mounted within a collector of the total internal reflectance type. The photoelectric cell has the form of a rod of a monocrystalline element or compound with a generally cylindrical junction spaced at a distance radially inwardly from the outer surface of the rod. The photoelectric cell is mounted within a trough shaped collector which is at least partially filled with a transparent solid wherein total internal reflectance of incident radiation increases the effectiveness of the collector.

54369 Tubular solar cell devices. Mlavsky, A.I. (to Mobil Tyco Solar Energy Corp.). US Patent 29,833. 14 Nov 1978. Filed date 9 Aug 1977. 20p.

Tubular solar cells are provided which can be coupled together in series and parallel arrays to form an integrated structure. Solar energy concentrators are combined with the solar cells to maximize their power ouptut. The solar cells may be cooled by circulating a heat exchange fluid through the interior of the solar cells and the heat captured by such fluid may be utilized, for example, to provide hot water for a heating system. The coolant circulating system of the solar cells also may be integrated with a solar thermal device so as to form a two stage heating system, whereby the coolant is preheated as it cools the solar cells and then is heated further by the solar thermal device.

54370 Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978. Ninety-Fifth Congress. Mutsunaga. Washington, DC; Committee on Energy and Natural Resources (1978). 16p. GPO.

The Committee on Energy and Natural Resources submitted the following report referring to S. 3392 which provides for an accelerated program of research, development, and demonstration of solar photovoltaic energy technologies leading to early competitive commercial applicability of such technologies. The Committee and other Federal agencies considered the bill and provides in this report amendments and recommends that the bill as amended be passed. The text of the bill is presented. The purpose of the measure is to establish the program over the next decade in DOE, provide for comprehensive planning and progamming, and to authorize to be appropriated to DOE $125 million in Fiscal 1979. Background and need, legislative history, Committee recommendations and tabulation of votes, Committee amendments, and a section-by-section analysis (15) are included. (MCW)

54371 Recent progress in thin film polycrystalline solar cells based on cadmium sulfide. Meakin, J.D. (Univ. of Delaware, Newark). *SPIE Semin. Proc.;* **114**: 2-6(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

Recent developments in thin film polycrystalline cells based on CdS/Cu_2S have established this cell as a major contender for large scale terrestrial application. Conversion efficiencies for CdS/Cu_2S now exceed 8%, with firm reason to believe that 10% is achievable. A modified cell using (CdZn)S is expected to be capable of about 15% conversion efficiency.

54372 Photovoltaic effects in II-VI heterojunctions. Bube, R.H. (Stanford Univ., CA). *SPIE Semin. Proc.;* **114**: 7-13(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

Photovoltaic effects have been investigated in II-VI heterojunctions prepared by close-space vapor transport, vacuum evaporation, spray pyrolysis and sputtering. Solar efficiencies of about 8% have been measured for the following systems: (a) n-CdS film deposited on single crystal p-CdTe by vacuum evaporation, (b) n-ZnCdS film deposited on single crystal p-CdTe by spray pyrolysis, and (c) n-Indium-Tin Oxide film deposited on single crystal p-CdTe by sputtering in an inert atmosphere. Open-circuit voltages greater than 0.8 V have been measured in heterojunctions of type (b) and (c), as well as in CdTe p-n homojunctions produced by ion implantation.

54373 High efficiency solar cells based on indium phosphide. Shay, J.L. (Bell Telephone Labs., Holmdel, NJ); Wagner, S.; Bachmann, K.J.; Buehler, E. *SPIE Semin. Proc.;* **114**: 16-19(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

Single crystal InP-CdS solar cells are reported having AM2 efficiencies of 15% and polycrystalline thin-film cells having AM2 efficiencies of 5.7%. Basic studies of the interface reveal that the thin-film efficiency is presently limited at least in part by the quality of the InP within the grains, and not exclusively by interface phenomena intrinsic to a polycrystalline cell.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 54276

54374 (COO—5035-1) **Herbaceous Species Screening Program. Technical progress report: first quarter.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). 15 Feb 1979. Contract ET-78-C-02-5035. 90p. Dep. NTIS, PC A05/MF A01.

The screening methodology is outlined and the preliminary selection of species with potential for biomass productivity is presented for the regions where herbaceous biomass production appears most feasible. The literature review, region delineation, technical and economic species screening, and field screening research design are presented. (MHR)

54375 (SRO—0903-2) **Fuel plantation research. Progress report.** Stubbs, J. (Forest Service, Aiken, SC (USA). Southeastern Forest Experiment Station). Aug 1977. Contract EY-76-A-09-0903. 114p. Dep. NTIS, PC A06/MF A01.

Research in chemical induction of lightwood is summarized. Four large-scale proof of concept studies have been installed that test five paraquat treatments on a total of 71,228 trees. This wood will be used in actual pulp mill and extraction plant runs to determine oleoresin recovery and possible processing problems. Nearly 3,000 wood samples have been collected to ascertain duration of treatment effects. Results of complementary studies are also reported; most of these are concerned with optimization of paraquat application techniques and the effect of species differences on these methods. A large study was installed to field screen selected insecticides for insect pest control in lightwood operations, and interim results are presented. Dowco 214 (Reldon) proved to be an adequate substitute for BHC and 0.5% concentrations were as effective as 1%. Ten northern and seven western conifer species were tested for their reaction to paraquat treatment. All members of genus Pinus showed appreciable resin soaking but other coniferous genera did not. Feasibility of oleoresin substitution for petrochemicals was investigated.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

54376 (COO—4178-2) **Photochemical energy storage: studies of inorganic photoassistance agents. Progress report, April 1, 1978-March 31, 1979.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1978. Contract EY-76-S-02-4178. 17p. Dep. NTIS, PC A02/MF A01.

Research in the contract period has focused on the study of photosensitive surfaces derivatized with redox active ferrocene-centered molecules. Surfaces studied include Au, Pt, Ge, Si, and GaAs using three different derivatizing reagents. In all cases, persistently-attached, electroactive material can be bound to the surface and characterized by cyclic voltammetry. The highlight of the research has been the demonstration that derivatized n-type Si can be used as a photoanode in aqueous electrolytes under conditions where the naked surface is passivated by photoinduced oxide growth (Si → SiO/sub x/) too fast to allow any useful measurements.

54377 (COO—4380-2) **Organic photochemical storage of solar energy. Progress report, March 1, 1978-January 31, 1979.** Jones, G. II. (Boston Univ., MA (USA). Dept. of Chemistry). Feb 1979. Contract EG-77-S-02-4380. 24p. Dep. NTIS, PC A02/MF A01.

Photosensitization mechanisms for driving energy storing reactions of readily available organic compounds have been studied. Aromatic sensitizers were used as complexing agents for a series of non-conjugated dienes which are capable of valence isomerization. Diene exciplexes, shown to be stabilized by electron donor-acceptor interaction, led to photoisomers with high chemical and quantum efficiency in two of the cases studied. For other systems, sensitizer-diene photoaddition reactions were observed. Exciplex isomerization of quadricyclanes and hexamethyldewarbenzene was studied. Factors determining the efficiency of rearrangement of excited complexes were examined including the role of exciplex excitation energy in controlling the novel adiabatic exciplex isomerization of hexamethyldewarbenzene. With triplet photosensitizers visible light (to 520 nm) was used to bring about an energy storing valence isomerization of a diester derivative of norbornadiene. High quantum yields (0.6) were measured at the longest wavelengths yet utilized for this type of isomerization. The quantum efficiency for isomerization using a very low energy triplet sensitizer was significantly enhanced at slightly elevated temperatures, suggesting that thermal energy (in amounts present in solar collector media) can be an aid in driving energy storing photo-reactions.

54378 (SAND—79-0736C) **Chemical storage of solar energy with photoelectrochemical cells.** Ginley, D.S. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-790515—1). Dep. NTIS, PC A02/MF A01.

From International assembly on energy storage; Dubrovnik, Yugoslavia (27 May 1979).

The theory of operation of photoelectrochemical cells is briefly described and problems in the development of optimum electrodes are discussed. (WHK)

54379 (SRO—893-15) **Development of a practical photochemical energy storage system. Quarterly report.** Hautala, R.R.; Kutal, C.R. (Georgia Univ., Athens (USA). Dept. of Chemistry). 15 Sep 1978. Contract EY-76-S-09-0893. 12p. Dep. NTIS, PC A02/MF A01.

A study of a series of copper(I) compounds which contain a strongly absorbing chromophore (e.g., $CuBr(PPh_3)$-(2,2'-bipyridine)) for use as sensitizers in photochemical energy storage systems is described. The generally low sensitization efficiencies of these compounds preclude their use as sensitizers in a practical photochemical energy storage system. Nevertheless, some interesting mechanistic information has emerged from this study, the full details of which are being written for publication. Also, the related compound, $Ru(bipy)_2(NBD)^{+2}$, which features a norbornadiene molecule coordinated directly to a strongly absorbing metal containing fragment was examined. The original rationale for studying this compound was the expectation that the absorption of visible light would result in the population of an electronically excited state in which the electron density of the NBD is considerably perturbed. Relaxation of this state could then occur by a pathway which leads to the rearranged product, quadricyclene. It was found, however, that the sensitization efficiency of this compound is quite low. A comprehensive study of the factors which affect the sensitization efficiencies of $Ir(bipy)_2(bipy')OH_2^{+3}$ is unerway. In order to elucidate the mechanism(s) by which organic sensitizers affect the conversion of norbornadiene to quadricyclene, a study to measure the actual rate constant for the sensitization process is underway. The status of the project is discussed.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 54295, 54317, 55108

54380 (CONF-781191—, pp 2.140-2.144) **Analysis methodology: photovoltaic central station power plants.** Leonard, S.L. (Aerospace Corp., El Segundo, CA). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

A block diagram for the comparison of a photovoltaic central station power plant and a conventional alternative is presented. The assumptions on which the comparison is based are outlined and regional breakeven array prices in the year 2000 are given.

54381 (CONF-781191—, pp 2.145-2.150) **Photovoltaic utility worth.** Finger, S. (Massachusetts Inst. of Tech., Cambridge). 1978.

From DOE photovoltaics technology development and applications program review conference; Arlington, VA, USA (7 Nov 1978).

The value of photovoltaics to utilities due to operating and capital cost savings in dollars per peak watt is presented as a function of photovoltaic precent of system for several regions of the US. The worth of photovoltaics is shown to be sensitive to the correlation of solar peak output with utility peak demand, the availability of storage, and the system load factor.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 54291, 54438, 55108

54382 (DOE/JPL—1060-9) **Thermal power systems: Small Power Systems Applications Project. Volume II. Detailed report. Annual technical report, fiscal year 1978.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jan 1979. Contract EX-76-A-29-1060. 212p. Dep. NTIS, PC A10/MF A01.

Small Power Systems Applications activities for FY 1978 are reported. Studies were conducted to address current small power system technology as applied to power plants up to 10 MWe in size. Markets for small power systems were characterized and cost goals were established for the project. Candidate power plant system design concepts were selected for evaluation and preliminary performance and cost assessments were made. Economic studies were conducted at JPL and under contract to Burns and McDonnell. Breakeven capital costs were determined for leading contenders among the candidate systems. An applications study was made of the potential use of small power systems in providing part of the demand for pumping power by the extensive aqueduct system of California, estimated to be 1000 MWe by 1985. Criteria and methodologies were developed for application to the ranking of candidate power plant system design concepts. Experimental power plants concepts of 1 MWe rating were studied by three contractors as a Phase I effort leading toward the definition of a power plant configuration for subsequent detail design, construction, testing and evaluation as Engineering Experiment No. 1 (EE No. 1). Site selection criteria and ground rules for the solicitation of EE No. 1 site participation proposals by DOE were developed.

54383 (DOE/JPL—1060-9(Vol.1)) **Thermal Power Systems, Small Power Systems Applications Project. Annual technical report. Volume I. Executive summary, Fiscal Year 1978.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jan 1979. Contract EX-76-A-29-1060. 75p. (JPL-PUB—79-43(Vol.1)). Dep. NTIS, PC A04/MF A01.

This report is a summary of the SPSA Annual Technical Report. It covers Small Power Systems Applications activities for FY 1978. Studies were conducted to address current small power system technology as applied to power plants up to 10 MWe in size. Markets for small power systems were characterized and cost goals were established for the project. Candidate power plant system design concepts were selected for evaluation and preliminary performance and cost assessments were made. Economic studies were conducted at JPL and under contract to Burns & McDonnell.

Breakeven capital costs were determined for leading contenders among the candidate systems. An applications study was made of the potential use of small power systems in providing part of the demand for pumping power by the extensive aqueduct system of California, estimated to be 1000 MWe by 1985. Criteria and methodologies were developed for application to the ranking of candidate power plant system design concepts. Experimental power plants concepts of 1 MWe rating were studied by three contractors as a Phase I effort leading toward the definition of a power plant configuration for subsequent detail design, construction, testing, and evaluation as Engineering Experiment No. 1 (EE No. 1). Site selection criteria and ground rules for the solicitation of EE No. 1 site participation proposals by DOE were developed.

54384 (DOE/JPL—1060-17) **Effects of regional insolation differences upon advanced solar thermal electric power plant performance and energy costs.** Latta, A.F.; Bowyer, J.M.; Fujita, T.; Richter, P.H. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Mar 1979. Contract EX-77-A-29-1060. 117p. Dep. NTIS, PC A06/MF A01.

This study determines the performance and cost of four 10 MWe advanced solar thermal electric power plants sited in various regions of the continental United States. Each region has different insolation characteristics which result in varying collector field areas, plant performance, capital costs and energy costs. In the context of advanced technology, the solar plants are conceptualized to begin commercial operation in the year 2000. The paraboloidal dish, central receiver, cylindrical parabolic trough, and compound parabolic concentrators comprise the advanced collector concepts studied. All concepts exhibit their best performance when sited in regional areas such as the sunbelt where the annual insolation is high. The regional variation in solar plant performance has been assessed in relation to the expected rise in the future cost of residential and commercial electricity supplied by conventional utility power systems in the same regions. A discussion of the regional insolation data base, a description of the solar systems' performance and costs, and a presentation of a range for the forecast cost of conventional electricity by region and nationally over the next several decades are given.

54385 (SAND—79-0379) **Midtemperature Solar Systems Test Facility experiment manual and test plan.** (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 52p. Dep. NTIS, PC A04/MF A01.

This manual describes the Midtemperature Solar Systems Test Facility (MSSTF), outlines the procedures for selecting items to be evaluated there, defines the prerequisites for installing such items, describes typical tests performed, and lists the reports generated and disseminated from the facility.

54386 (SERI/TP—34-169) **Performance characteristics of a commercially available, point-focus, solar power system.** Bohn, M. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1979. Contract EG-77-C-01-4042. 12p. (CONF-790808—17). Dep. NTIS, PC A02/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

The performance of a commercially available solar electric power system is described in terms of instantaneous electrical power output for a given insolation and electrical energy production per day. Receiver thermal loss coefficient and concentrator optical efficiency are measured and system performance is then given with steam cycle efficiency and electrical generator efficiency as parameters. System performance is limited by a relatively low optical efficiency of 44%. For peak insolation, this collector delivers 9.2 kw./sub th/ to the steam engine, representing 35% of the solar input.

CENTRAL RECEIVER

54387 (DOE/JPL—1060-24) **Evaluation of cellular glasses for solar mirror panel applications.** Giovan, M.; Adams, M. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jun 1979. Contract EX-76-A-29-1060. 96p. Dep. NTIS, PC A05/MF A01.

An analytic technique is developed to compare the structural and environmental performance of various materials considered for backing of second surface glass solar mirrors. Metals, ceramics, dense molded plastics, foamed plastics, forest products and plastic laminates are surveyed. Cellular glass is determined to be a prime candidate due to its low cost, high stiffness-to-weight ratio, thermal expansion match to mirror glass, evident minimal environmental impact and chemical and dimensional stability under conditions of use. While applications could employ this material as a foam core or compressive member of a composite material system, the present analysis addresses the bulk material only, allowing a basis for simple extrapolations. The current state of the art and anticipated developments in cellular glass technology are discussed. Material properties are correlated to design requirements using a Weibull weakest link statistical method appropriate for describing the behavior of such brittle materials. A mathematical model is presented which suggests a design approach which allows minimization of life cycle cost; given adequate information for a specific aplication, this would permit high confidence estimates of the cost/performance factor. A mechanical and environmental testing program is outlined, designed to providea material property basis for development of cellular glass hardware, together with methodology for collecting lifetime predictive data required by the mathematical treatment provided herein. Preliminary material property data from measurements is given.

54388 (SAND—79-1295C) **Modeling the beam characterization system.** Biggs, F.; Vittitoe, C.N.; King, D.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 20p. (CONF-791005—4). Dep. NTIS, PC A02/MF A01.

From ISA national conference; Chicago, IL, USA (22 Oct 1979).

The Beam Characterization System (BCS) recently developed for heliostat evaluation at the Central Receiver Test Facility at Sandia Laboratories, measures, digitizes, records, and analyzes a flux-density pattern in a beam of reflected sunlight. Since the BCS collects data with a given set of conditions (geometry, weather, etc.) to determine optical specifications which can predict heliostat behavior under other sets of conditions, it is necessary to use a theoretical model of the system to interpret results. This model serves as an aid to define specifications, analyze measurements, calculate performance, and answer other questions about the heliostat. A statistical method is used to handle stochastic variables such as sun-tracking errors and surface-slope errors. A cone-optics technique is used to incorporate the statistics into a consistent model of the optical behavior of a heliostat. An overview of this model is given. Use of the model is unfolding slope-error distributions and sun-tracking statistics is described for measurements both in and out of the focal plane. The importance of auxiliary input information such as the sunshape (angular distribution of sun rays) to the analysis of BCS measurements is discussed. Finally, the role of the BCS in validating heliostats against acceptance criteria is summarized.

54389 (SAND—79-1532C) **Heliostat beam characterization system-calibration technique.** Phipps, G.S. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 23p. (CONF-791005—2). Dep. NTIS, PC A02/MF A01.

From ISA national conference; Chicago, IL, USA (22 Oct 1979).

The Beam Characterization System (BCS) used at the Central Receiver Test Facility digitizes the output signal from a standard 525-line video camera to obtain raw data for measurements of solar heliostat images. A rapid data rate and relative availability of off-the-shelf equipment favor the use of a video camera system, but the problem of an accurate absolute radiometric calibration must be addressed. Absolute irradiance values are obtained from a calibrated pyrheliometer included on the target screen. The video camera must measure relative irradiance values of areas of identical spectral composition, greatly simplifying the calibration procedure. Not only must the camera and digitizer linearity be measured, but imaging screen reflectance, lens and filter effects, and camera spatial sensitivity must also be considered for accurate results. Measurements are made over a two dimensional spatial array of N screen locations. Calibration corrections must be applied to the data from the N locations to obtain a single calibrated irradiance data matrix. Methods of obtaining these corrections are discussed and measured results are presented to support the various assumptions.

54390 **Solar thermal electric power plant.** Smith, O.J.M. US Patent 4,164,123. 14 Aug 1979. Filed date 25 Aug 1976. 12p.

A solar thermal electric energy system is described utilizing a solar receptor having a double paned glass window with cooling liquid circulating therethrough. This serves as a window for a solar heat receptor cavity having a number of water or steam carrying tubes therein. A portion of the tubes operate at a temperature range suitable for heating boiler water and another portion of the tubes is at a higher temperature which serves as steam superheat. The liquid flowing through a pair of window panes is triethylene glycol and in addition to cooling the window has an index of refraction which matches the window to provide the most efficient conduction of solar energy to the heat recepting tubes behind the window. The power plant itself includes heat saving jackets around the steam headers to provide for boiler feed water preheat and has both high pressure and low pressure turbines to utilize most efficiently the water being heated by the solar receptors.

54391 **Five MW Solar Thermal Test Facility heliostat focus and alignment system.** Oldham, L.P. (Martin Marietta Corp., Denver, CO). *SPIE Semin. Proc.;* **114**: 52-59(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

A unique system has been developed to focus and align the nearly 8000 mirrors for our nation's first Central Receiver Solar Thermal Test Facility, located at Albuquerque, New Mexico. The computer controlled system utilizes a laser light source which is scanned over a 61 inch diameter collimating mirror to simulate a collimated solar beam. The collimator and laser source are mounted on a microprocessor controlled precision pointing mount with 0.1

milliradian pointing accuracy. Control of the system is achieved through a vehicle mounted terminal plugged directly into the control electronics of the heliostat undergoing alignment. The simulated solar beam is reflected from the heliostat mirror and imaged onto a retroreflective target screen. The screen is observed by an integrating video system over the period of a complete laser scan. Alignment is achieved through computer simulation of the sun/heliostat/receiver geometry for a selectable time and day of the year. An overview of the Solar Thermal Test Facility and a detailed description of the Focus and Alignment System are presented.

DISTRIBUTED COLLECTOR

54392 (DOE/JPL—1060-7(Vol.2)) **Thermal Power Systems, Point-Focusing Distributed Receiver Technology Project. Annual technical report, Fiscal Year 1978. Volume II. Detailed report.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Mar 1979. Contract EX-76-A-29-1060. 123p. (JPL-PUB—79-1(Vol.2)). Dep. NTIS, PC A06/MF A01.

Thermal or electrical power from the sun's radiated energy through Point-Focusing Distributed Receiver technology is the goal of this Project. The energy thus produced must be economically competitive with other sources. This Project supports the industrial development of technology and hardware for extracting energy from solar power to achieve the stated goal. Present studies are working to concentrate the solar energy through mirrors or lenses, to a working fluid or gas, and through a power converter change it to an energy source useful to man. Rankine-cycle and Brayton-cycle engines are currently being developed as the most promising energy converters for our near future needs. Accomplishments on point-focusing technology in FY 1978 are detailed.

54393 (DOE/JPL—1060-23) **Performance prediction evaluation of ceramic materials in point-focusing solar receivers.** Ewing, J.; Zwissler, J. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Jun 1979. Contract EX-77-A-29-1060. 5p. Dep. NTIS, PC A04/MF A01.

A Performance Prediction Model was adapted to evaluate the use of ceramic materials in solar receivers for point-focusing distributed applications. TPS system requirements were determined including the receiver operating environment (such as concentrator performance and environment/natural occurrences) and system operating parameters for various engine types. Preliminary receiver designs evolve from these system requirements. Specific receiver designs evaluated in this report to determine material functional requirements include the NRL solchem converter/heat exchanger, MIT/LL ceramic dome. Black and Veatch/EPRI ceramic tube receiver, and the Sanders honeycomb matrix Brayton receiver. Status of the first phase of a continuing task of evaluation and reporting on high temperature ceramics for solar thermal receiver applications is described. Subsequent reports will develop the Performance Prediction Model in more detail and provide data on its use in the several high temperature receiver and reactor designs planned for or under development.

TOTAL ENERGY AND HYBRID SYSTEMS

54394 (CONF-790803—43) **Combined cycle for solar-fossil hybrid power generation.** Lam, E.Y.; Westsik, J.H. (Bechtel National, Inc., San Francisco, CA (USA)). 1979. Contract ET-78-C-03-2051. 5p. Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

A study of the combined cycle solar hybrid system concept was initiated in October, 1978 at Bechtel as part of the solar power development program of the Department of Energy (DOE). Parametric studies were conducted on a near term and an advanced version of a nominal 100 MWe (net) commercial power system. These studies, combined with analyses of market potential in the 1985-1990 time frame, will serve as bases for selecting one of these two concept versions for conceptual design during the second half of this 12 month study. A technical and economic assessment of the concept and the preparation of a development plan and proposal will complete the study project. The combined cycle hybrid system selected by the Bechtel team for the study consists of an air operated open Brayton cycle with a steam Rankine bottoming cycle utilizing the gas turbine waste heat. Solar energy is used to preheat the air in the gas turbine cycle, with the air cooled receiver, located upstream from the combustor in a series arrangement. Cycle efficiencies of 43.5 and 47.7 percent and average annual solar fractions of .312 and .408 were predicted for the near term and advanced versions respectively.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 54290

54395 (ANL/OTEC-BCM—002) **Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.** (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 349p. Dep. NTIS, PC A15/MF A01.

The 23 papers presented are entered in the data base separately. Round table sessions on measurement of R/sub f/ and analysis of heat transfer data, biology of fouling, corrosion and the application of materials, and fouling and countermeasures are included. (WHK)

54396 (ANL/OTEC-BCM—002, pp 3-12) **Requirements for Biofouling, Corrosion, and Materials in the OTEC Program.** Kinelski, E.H. (Dept. of Energy, Washington, DC). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virgina.

Investigations in the OTEC Biofouling, Corrosion, and Materials Program emphasize heat transfer as influenced by biofouling, corrosion, biofouling and its countermeasures, and materials selection. A review of the data reported indicates that a large number of unknowns still exist. The objective of this Workshop is to establish guidelines for satisfactory solutions.

54397 (ANL/OTEC-BCM—002, pp 13-17) **Overview of Biofouling, Corrosion, and Materials Program.** Draley, J.E. (Argonne National Lab., IL). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The current and near future OTEC Biofouling, Corrosion, and Materials Program is described.

54398 (ANL/OTEC-BCM—002, pp 21-31) **Interpretation and implications of OTEC biofouling data.** Fetkovich, J.G. (Carnegie-Mellon Univ., Pittsburgh, PA). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

A physical model of the characteristics of OTEC heat exchanger biofouling is described. (WHK)

54399 (ANL/OTEC-BCM—002, pp 32-37) **Preliminary results from Ke-ahole buoy deployment No. 3.** White, H. (Univ. of Hawaii, Honolulu). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Preliminary results of heat transfer changes of materials due to biofouling and corrosion at Ke-ahole Point are presented. The four materials tested were aluminum 5057, titanium SB-337, stainless steel AL-6X, and copper-nickel alloy 90-10. (WHK)

54400 (ANL/OTEC-BCM—002, pp 38-55) **Biofouling assays for OTEC pipes.** Berger, L.R.; McCoy, W.F.; Berger, J.A. (Univ. of Hawaii, Honolulu). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Progress is reported on a project to perform a chemical analysis of biofouling layers on sample OTEC pipe surfaces taken at Keahole Point, Hawaii. Sample removal and preparation procedures are described. Chemical analysis procedures are described for determining proteins, organic iron, ATP and FMN, inorganic iron, and polygalacturonic acids. (WHK)

54401 (ANL/OTEC-BCM—002, pp 56-59) **Anti-fouling marine concrete.** O'Neill, T.B.; Mathews, C.W. (Naval Construction Battalion Center, Port Hueneme, CA). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The ultimate objective of this project is to develop a long-lasting, environmentally safe, and structurally sound concrete with anti-fouling and anti-pholad properties. It is intended that the concrete will be used to line the inner surface of seawater intake ducts and to form the basic floating structure of an OTEC plant. This report deals with the techniques for incorporating antifouling chemical mixtures into concrete, the subsequent testing of the resulting concrete for compressive strength and shear strength, as well as antifouling properties. The rate of corrosion of reinforcing rods embedded in the concrete as well as a study of the outward diffusion of antifouling chemicals from concrete have been initiated. The minimum effective concentration of antifouling agents will be determined. To date concrete test cylinders have been exposed for periods of four months to one year at Port Hueneme, California, Key West, Florida, and Miami, Florida. The antifouling agents under test are Tributyltin oxide (TBTO), Cuprous Oxide (Cu_2O), Creosote and mixtures of these.

54402 (ANL/OTEC-BCM—002, pp 60-100) **Gulf of Mexico Ocean Thermal Energy Conversion (OTEC) biofouling and corrosion experiment.** Little, B.; Lavoie, D. (NORDA, Bay St. Louis, MS). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

A model OTEC heat exchanger system containing 2 loops of 5052 aluminum, was mounted on a National Oceanographic and Atmospheric Administration (NOAA) 40-ft discus buoy. Water from 80-ft depth was pumped through the loops at flow rate of 6 ft/sec for approximately six weeks. Sections of the sample loops were removed periodically and the resulting fouling characterized by the following parameters: wet film thickness, film density, adenosine triphosphate (ATP) and total organic carbon. Scanning electron microscopy was used to describe the surface features of the pipe interiors and to identify the types of fouling organisms. Heat transfer was measured and the data reported as resistance due to fouling (R/sub f). The objective of this experiment was to relate the character of the biofouling/corrosion film to the observed loss in heat transfer efficiency. Results are presented in detail.

54403 (ANL/OTEC-BCM—002, pp 101-120) **Measurement of microfouling mass and community structure during succession in OTEC simulators: a preliminary report.** Bobbie, R.J. (Florida State Univ., Tallahassee); Nickels, J.S.; Davis, W.M.; White, D.C.; Lott, D.F.; Dyjak, R.; Hollowell, J. 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The initial task of this laboratory is to develop microassays for the biomass, physiological state and population structure of the microfouling community in the Naval Coastal Systems Center OTEC simulation system. These methods involve the measurement of biochemical parameters that characterize different components of the community of more or less specifically indicate the metabolic status of the population. Experimental procedures and results are discussed. 54 references.

54404 (ANL/OTEC-BCM—002, pp 121-122) **Macrofouling at the Gulf of Mexico OTEC site.** DePalma, J.R. (Naval Oceanographic Office, Bay St. Louis, MS). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

54405 (ANL/OTEC-BCM—002, pp 123-145) **OTEC Gulf of Mexico Experiment (GOME).** Spiehler, F.A.; Remond, F.X.; Hammett, B.E. 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The purpose of the OTEC-GOME project is to obtain in situ experimental data on the biofouling, corrosion, and heat transfer characteristics of tubes of four different metals (aluminum, titanium, stainless steel A1-6x, and 90-10 copper-nickel) in test sections by drawing sea water from a depth of approximately 75 feet. The heat transfer monitor experiment will provide a fundamental understanding of the mechanism of biofouling microfilm buildup on tube walls and its critical relationship to heat transfer efficiency. The Johns Hopkins water box experiment will provide data on corrosion and biofouling on the exterior exposed surface of aluminum tubes at heat exchanger flow rates of sea water. The water box data will be used to develop tube cleaning techniques. Additional objectives of the overall project are as follows: (1) to place test panels, or coupons, of various metals and materials at several depths to study the effect of depth on biofouling and corrosion; (2) to collect marine borers on wood test panels at several depths and classify them; (3) to study the effects of macrofouling on buoy structure and inlet water pipes and mooring; and (4) to gain experience with the problems of supporting and servicing an offshore OTEC experiment. The test system design and deployment and results are described.

54406 (ANL/OTEC-BCM—002, pp 149-162) **Preliminary evaluation of flow-driven brushes for removal of soft biofouling from heat exchanger tubes in OTEC power plants.** Braswell, J.A.; Lott, D.F.; Hedlicka, S.M. (Naval Coastal Systems Center, Panama City, FL). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Preliminary investigation of flow-driven brushes for removal of soft biofouling accumulations (primary slimes) from the internal surfaces of sea-water cooled heat exchanger tubes has been completed. The cleaning ability of a commercial system was measured with single tube heat transfer monitors. The evaluation indicates that flow-driven brushing every 8 hours will maintain an acceptably low fouling resistnace (less than 0.0005 ft^2-h-°F/BTU) in cylindrical titanium tubes nut not in aluminum alloy tubes of the same configuration. Plans for an evaluation of chlorination as well as continued investigation of mechanical cleaning techniques are discussed.

54407 (ANL/OTEC-BCM—002, pp 163-180) **Review of water intake screening options for coastal water users with recommendations for ocean thermal energy conversion (OTEC) plants.** Thomas, D.L. (University City Science Center, Philadelphia, PA). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The large volumes of water withdrawn at both the warm and cold water intakes of an OTEC plant must be screened to remove organisms and debris which could clog the heat exchangers. The recent literature on screening is reviewed. In addition, various screen manufacturers and coastal facilities which use large volumes of seawater were visited to determine the operating experience with present screen technology. Static screens (particularly the Johnson Division, UOP profile wire screen and the Royce Equipment Company carrousel screen) have the potential advantage for OTEC of operating in a completely submerged state and of being cheaper to operate and maintain than traveling screens. However, there is no operational history with these static screens for large intake systems. The most promising traveling screen options for OTEC are the dual flow screens. They offer more screening surface and less head loss than through flow screens of similar size. They also have been operated in seawater for large intake systems. More detailed designs of potential OTEC plants, particularly screen wells, conduit and surge tank construction and head losses need to be determined before the best alternative intake screen can be selected.

54408 (ANL/OTEC-BCM—002, pp 181-186) **Nonbiogenic deposits at the OTEC heat exchanger-seawater interface.** Morse, J.W. (Univ. of Miami, FL). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The deposits, which may form on OTEC heat exchangers, can be divided into three major categories; corrosion products, precipitates from fluids, and living organisms and their products (biofouling). Only corrosion products and precipitates are likely to form at the working fluid-heat exchanger interface. All three major types of deposits are likely to form at the seawater-heat exchanger interface, and they can be expected to be inter-related in a complex manner. A brief discussion is presented of the status of knowledge about nonbiogenic deposits at the seawater-heat exchanger interface and recommendations are made for further tests.

54409 (ANL/OTEC-BCM—002, pp 189-196) **Corrosion of aluminum and titanium at Keahole Point over an eight month period.** Liebert, B.E. (Univ. of Hawaii, Honolulu). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Aluminum and titanium samples were exposed to flowing seawater on an underwater buoy off Keahole Point, Hawaii. Samples were periodically removed to determine the nature and amount of both the biofouling and corrosion products. This is concerned only with the corrosion aspect. The results over an 8 month period indicate that whereas the titanium samples were unaffected, the corrosion product film of the aluminum samples increased in thickness parabolically with time. No evidence of pitting was found on any of the samples examined. The results indicate that if the corrosion product film is not removed by brushing or dissolution, then a corrosion loss of only 100μm (4 mils) is predicted over a 30 year lifetime.

54410 (ANL/OTEC-BCM—002, pp 197-216) **Corrosion of aluminum and titanium during the first Gulf of Mexico buoy deployment.** Poteat, L.E.; Dale, W.G. (Univ. of Miami, FL). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The OTEC Buoy was deployed in the Gulf of Mexico from March 16, 1978 thru June 7, 1978. During this time the University of Miami conducted the corrosion assessment study to evaluate the aluminum and titanium pipes used for the experiment. The specific tasks for this study were to develop field procedures and requirements for the acquisition of corrosion data on the pipes used on the buoy. The experimental procedure and results are presented.

54411 (ANL/OTEC-BCM—002, pp 217-226) **Resistance of OTEC heat exchanger alloys to marine exposures under conditions of crevice corrosion and corrosion accelerated by mechanical abrasion.** Lee, T.S.; Kain, R.M.; Tipton, D.G. (International Nickel Co., Inc., Wrightsville Beach, NC). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Experimental procedures for assessing the susceptibility of candidate OTEC heat exchanger materials to localized corrosion phenomena and assessing the effects of mechanical cleaning on the corrosion behavior of candidate OTEC heat exchanger materials are described. The seven candidate alloys that will be tested are listed. (WHK)

54412 (ANL/OTEC-BCM—002, pp 227-248) **Interleakage of ammonia and seawater in OTEC heat exchangers: effects on corrosion and scale formation.** Schrieber, C.F.; Grimes, W.D.; McIlhenny, W.F. (Dow Chemical U.S.A., Freeport, TX). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The purpose of this effort was to assess the influence of seawater-ammonia mixtures on proposed OTEC heat exchanger materials at environmental conditions simulating an OTEC plant exposure. Testing was to remain on a coupon test scale, and relevant information sought included degree and definition of chemical scaling, general corrosion rates, pitting, crevice corrosion, and influence of intermittent but sequential chemical and mechanical cleaning. Heat exchanger materials included commercially pure (CP) titanium, and aluminum alloys 3003, 5052, and 5086. Additionally, specimens of aluminum alloy 5052 pretreated in boiling deionized water were included in all exposures. The possibility of either an ammonia or seawater intrusion (leak) in either the OTEC evaporator or condenser, constituted the stimulus for this research on candidate OTEC heat exchanger materials. The concern was that low concentrations of ammonia in seawtaer, and conversely, low concentrations of seawater in ammonia, may act to seriously impair material performance. The results of the experimental testing program carried on at Freeport from September 1977 until January 1979 are summarized.

54413 (ANL/OTEC-BCM—002, pp 249-251) **Qualification of metals and alloys for OTEC heat exchangers: present status.** LaQue, F.L. 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Qualification of the AL-6X alloy for use as tubing in OTEC heat exchangers is discussed. Aluminum is neither qualified nor disqualified for use as tubes in OTEC heat exchangers, but relevant properties of aluminum are discussed. (WHK)

54414 (ANL/OTEC-BCM—002, pp 252-255) **OTEC corrosion/biofouling studies.** Rynewicz, J.F. 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

An OTEC heat exchanger test program is described. A heat transfer measurement device, two biofouling corrosion test loops, and a closed loop M.A.N. brush test are described. (WHK)

54415 (ANL/OTEC-BCM—002, pp 256-278) **Stress-corrosion cracking of steels in ammonia: a survey.** Teel, R.B. (Teel and Associates, Chatham, NJ). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Carbon steel and higher strength, quenched and tempered steel, when cold formed and/or welded, are subject to stress-corrosion cracking (SCC) in air-contaminated dry ammonia. The constituents in air responsible for SCC are oxygen and combinations of oxygen and nitrogen. Neither nitrogen nor carbon dioxide alone or combined contribute to this type failure. Water has been shown to be an effective inhibitor of SCC when present in the amount of 0.08 to 0.2% (wt) (800 to 2000 ppM). Hydrazine (N_2H_4) has also been shown to be an effective inhibitor of SCC when present at about the same concentration. A galvanic series for metals in ammonia has been established that shows metals to be arranged in a similar relative position as observed for metals in sea water. Little is known of galvanic effects in ammonia between steel and more noble metals such as titanium and stainless alloys. Where water has proven effective as an inhibitor of SCC in an all steel system, it may not be adequate in a mixed-metal system such as would be found in an OTEC plant using shell and tube heat exchangers. Additional research is required to determine the severity of the coupling effect, especially regarding the possibility of accelerated SCC failures of steel.

54416 (ANL/OTEC-BCM—002, pp 281-294) **Conceptual plan for a Seacoast Test Facility at Ke-ahole Point, Kona, Hawaii.** White, H.; Noda, E. (Univ. of Hawaii, Honolulu). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The proposed onshore OTEC test facility at Ke-ahole Point, Kona, Hawaii, is described. Diagrams and maps of the layout, buildings, pipe installation, and plumbing are included. (WHK)

54417 (ANL/OTEC-BCM—002, pp 295-310) **OTEC bofouling, corrosion, and materials study from a moored platform at Punta Tuna, Puerto Rico: design phase.** Sasscer, D.S.; Tosteson, T.R.; Pedersen, K.B.; Rosa, F.; Benitez, F.L. (Univ. of Puerto Rico, Mayaguez). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

The objectives of this investigaton are: (1) obtain a better understanding of the nature of the fouling that can be expected to occur in OTEC heat exchangers by a replicated, multi-seasonal determination of the effect of biogrowth, corrosion, and materials on the heat transfer coefficient; (2) determine the compatibility of Caribbean open ocean surface water with OTEC at a site where the local electrical utility has expressed an interest in cooperating with DOE in OTEC power plant development; and (3) investigate OTEC fouling on a versatile, permanently moored research platform which can be used for continued and/or expanded testing with surface water, and which can serve as a prototype for an OTEC test facility using both, surface and deep ocean water. The design phase of the program is described.

54418 (ANL/OTEC-BCM—002, pp 311-315) **Module for measuring R/sub f/ and collecting biological and corrosion specimens.** Gavin, A.P.; Rodin, M.; Popper, G.F. (Argonne National Lab., IL). 1979.

In Proceedings of the Ocean Thermal Energy Conversion (OTEC) Biofouling, Corrosion, and Materials Workshop, January 8-10, 1979, Rosslyn, Virginia.

Experiments for the OTEC Biofouling, Corrosion and Materials program are presently being conducted at several locations by different contractors and the future OTEC program envisions the involvement of several new sites and operators. The experiments normally performed at these sies usually include the determnation of the change in heat transfer coefficient due to fouling of the heat transfer tube surface (R/sub f/) and the evaluation with respect to the biofouling and corrosion of these tubes which have been exposed to the seawater. Experience to date has shown that if meaningful data which can be correlated between sites is to be obtained, it is essential that as far as possible equipment and procedures used by the contractors at the various sites be standardized. To accomplish this, the Argonne National Laboratory (ANL) Components Technology (CT) Division has been assigned the task of designing and assuring the availability of standard OTEC experiment modules to other projects. Each module is to contain a redesigned Heat Transfer Monitor (HTM), sufficient tubing sections to provide the required biofouling and corrosion samples and all of the pipe, valves, and auxiliary equipment required to evaluate a specific fouling countermeasures technique. Standard instruments, data acquisition and analysis systems are also to be developed along with standard procedures for the installation and operation of these modules. Development of the standard module is described.

54419 (LBL—9183) **Programmatic environmental impact assessment for operational OTEC platforms: a progress report.** Sands, M.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 10p. (CONF-790941—1). Dep. NTIS, PC A02/MF A01.

From MTS Oceans conference; San Diego, CA, USA (Sep 1979).

As the Ocean Thermal Energy Conversion (OTEC) Program advances toward commercialization, the potential environmental impacts of large-scale development must be assessed. Design modifications that will mitigate or reduce potentially adverse effects must be identified and incorporated into the design configurations. The key issues associated with the deployment and operation of demonstration- and commercial-size plants are under evaluation. Presently, three platforms design configurations are being considered: (1) a 10 to 20 MW/sub e/ land-based plant; (2) an industrial plant-ship operation; and (3) a 20 to 400 MW/sub e/ moored plant. In the program, the land-based plants are to be located on tropical or subtropical islands, while the plant-ships would graze in the open ocean, producing ammonia, hydrogen, or other energy-intensive products. The moored platform will transmit electricity through a cable to a shore-based distribution point. In this assessment, both individual platforms and a mix of the above are being considered for potential siting in the thermal resource regions. The key issues considered may be generically grouped into three categories: (1) social, economic and institutional impacts; (2) environmental impacts; and (3) health and safety on and adjacent to the platforms. While this program is not complete, the major findings to date are presented.

54420 (LBL—9495) **1979 status of the OTEC environmental program.** Wilde, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 11p. (CONF-791011—1). Dep. NTIS, PC A02/MF A01.

From Marine Technology Society conference; New Orleans, LA, USA (10 Oct 1979).

Preliminary surveys and laboratory studies are being conducted in the waters of Puerto Rico, the Gulf of Mexico, and Hawaii for moored or seacoast OTEC plants and in the equatorial South Atlantic for plant-ship operations to provide baseline data. These data plus existing archival information can be used to model effects of OTEC operations. Four major areas of concerns (1) redistribution of oceanic properties, (2) chemical pollution, (3) structural effects, and (4) socio-legal-economic; and 11 key issues associated with OTEC operation have been identified. Mitigating strategies can be used to alleviate many deleterious environmental effects of operational problems as biostimulation, outgassing, etc. Various assessment research studies on toxicity, biocide releases, etc., are under way to investigate areas where no clear mitigating strategy is available. Data from these programs is being integrated into a series of environmental compliance documents including a programmatic environmental impact assessment.

SOLAR RADIATION UTILIZATION

54421 History of solar energy applications solar energy yesterday, today, and tomorrow. Yellott, J.I. pp 9-18 of Energy from the sun. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from the sun; Chicago, IL, USA (3 Apr 1978).

Significant interest in applied solar energy arose nearly two centuries ago in France when Lavoisier and some of his contemporaries began to experiment with lens-type solar furnaces. One hundred years later, the French built solar-powered pumping engines with the goal of irrigating the deserts of Algeria. In the US, John Ericsson of "Monitor" fame built half a dozen solar engines employing both steam and hot air and he was followed by other engineers who built irrigation pumps ranging in size from a few horsepower to as many as 60. Solar space heating in the modern sense became a reality just after the end of World War II when both passive and active systems were the subject of intensive experimentation. Solar cooling was first accomplished in France in 1876, using the absorption system which had been discovered accidentally by Michael Faraday in 1829. Today's solar cooling sytems use the same principles and, particularly in the larger sizes which are required in major industrial and institutional buildings, they are proving to be competitive with compression systems powered by electric motors. The silicon solar cell, invented in the early 1950's, was the first efficient device in this field and it has become the standard method for power generation in space. The most effective solar system, from the economic point of view, is the domestic water heater which was first put to use in the US at the turn of the century. A thriving business sprang up in both California and Florida in manufacturing and installing solar water heaters, but the spread of the natural gas pipe lines put an end to this industry. It appears that, as natural gas begins to recede, solar water heaters will come into wide use throughout much of the US

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REFER ALSO TO CITATION(S) 54507, 55064

54422 (ALO—4261-T5) **Eighth monthly technical status report, December 1-December 31, 1978.** (Science Applications, Inc., McLean, VA (USA)). 20 Jan 1979. Contract EM-78-C-04-4261. 80p. Dep. NTIS, PC A05/MF A01.

Progress in all tasks is reviewed briefly. Charts which represent the monthly reports are included. The appendices include: a summary of additional needs, heat pump model description, heat pump model preliminary results, an interim report, and simplified methodologies. (MHR)

54423 (ALO—4261-T6) **Revised management plan, milestone plan, cost plan, and manpower plan. Sixth and seventh monthly status reports, October 1-November 30, 1978.** (Science Applications, Inc., McLean, VA (USA)). 1978. Contract EM-78-C-04-4261. 107p. Dep. NTIS, PC A06/MF A01.

The following are included: project background and discussion, technical progress reports for all subtasks, contract management summary report, milestone schedule and status report, milestone log, cost plans, cost management reports, manpower plans, and manpower management reports. The following appendices are included: selection of heat pumps simulation locations, economic computations, fuel costs, system studies, recommended methodology for calculating residential load models, potential performance of heat pumps, data required from cooling contractors, cooling locations, thermal outputs: cooling, recommended inputs for the 25 ton advanced cooling simulation study, meteorological data, and contract modification. (MHR)

54424 (BNL—51019) **Thermal mats for space heating and cooling.** Szydlik, P.P.; Berlad, A.L. (Brookhaven National Lab., Upton, NY (USA)). Mar 1979. Contract EY-76-C-02-0016. 20p. Dep. NTIS, PC A02/MF A01.

A study is made of a single solar-powered device (e.g., a flexible plastic mat with an air space or water channel) to accomplish both direct-gain heating and space cooling or water heating. In the former operating mode, heating load reductions of 10 to 30% can be achieved for small structures under cold, sunny midwinter weather conditions. With water flowing, cooling load reductions of 25% are obtainable with the mats attached to only one large surface of similar structures. The mats also possess significant water heating capability which is a function of flow rate as well as solar flux. When operated simultaneously as space-cooling devices, they can serve as efficient water preheaters. For lower flow rates, temperature rises are sufficiently high for direct coupling to domestic hot water supplies.

54425 (COO—4351-6) **Phoenix City of Colorado Springs solar assisted heat pump project. Technical report, December 1, 1977-April 1, 1978.** Jardine, D.M.; Jones, D.W. (Kaman Sciences Corp., Colorado Springs, CO (USA)). Jun 1978. Contract EG-77-C-02-4351. 225p. Dep. NTIS, PC A14/MF A01.

The design of packaged Solar Assisted Optimized Heat Pump (SAOHP) systems as a step towards stimulating the advancement of an industrial, commercial, and professional capability for producing and distributing this type of system is covered. The SAOHP system consists of a collector group, a ground coupled seasonal storage (GCSS) group, and an energy transport and distribution (ETD) group. The design for the collector group with first tier parts and assembly lists are included, along with the ETD group designs for the smaller capacity units. Rating curves are included for the 30,000 BtuH (2-1/2 ton), 36,000 BtuH (3 ton), 48,000 BtuH (4 ton), 60,000 BtuH (5 ton) and 90,000 BtuH (7-1/2 ton) units. All system revisions have been completed and the results of these revisions documented. The system analysis program, modified to compliance with NBS 76-1137 during the second quarter, has been successfully generating daily, weekly and monthly energy balances. Reliability of the SAOHP system has been fair this quarter and problems occurring are documented. Climatic region definition work is included in complete form. The economic analysis format for making life cycle cost comparisons between various available heating and cooling systems and the SAOHP is included. A list of visitors, project photographs and presentations are included in the appendices.

54426 (COO—4400-11) **Technical status report No. 11, December 15, 1978-March 15, 1979.** McColl, J.R. Jr.; Wade, W.H. (McColl-Wade, Inc., Branford, CT (USA)). 1979. Contract EG-77-A-02-4400. 3p. Dep. NTIS, PC A02/MF A01.

The objectives, progress summary, changes, and problem areas for this solar air heating and hot water system are reviewed briefly. (MHR)

54427 (DOE/ERD—0018) **Environmental Readiness Document: solar heating and cooling of buildings.** (Department of Energy, Washington, DC (USA)). Sep 1979. 28p. Dep. NTIS, PC A03/MF A01.

The technology is described briefly and the environmental concerns associated with it are reviewed. A status report on the technical and environmental R and D programs is provided and the relationship between the technical and environmental R and D is displayed in a milestone chart in terms of desirable timing. The likelihood of adverse findings concerning the environmental acceptability of the technology, the problems and uncertainties stemming from current or anticipated environmental regulation, and the potential costs of environmental controls are examined. An assessment is offered of the existing or potential barriers to commercialization. A tabulation of environmental concerns is presented with the research needed to resolve the concerns and its estimated cost. (MHR)

54428 (DOE/NASA/CR—161235) **Solar heating and hot water system installed at Cherry Hill, New Jersey.** (National Aeronautics and Space Administration, Washington, DC (USA); Garden State Racing Association, New Jersey (USA)). 16 May 1979. Contract EG-77-A-01-4086. 384p. Dep. NTIS, PC A17/MF A01.

The solar heating and hot water system installed in existing buildings at the Cherry Hill Inn in Cherry Hill, New Jersey is described in detail. The system went into operation November 8, 1978 and is expected to furnish 31.5% of the overall heating load and 29.8% of the hot water load. The collectors are General Electric Company liquid evacuated tube type. The storage system is an above ground insulated steel water tank with a capacity of 7,500 gallons.

54429 (DOE/NASA/CR—161271) **Solar heating and hot water system installed at Southeast of Saline, Unified School District 306, Mentor, Kansas.** (Wilson and Co., Salina, KS (USA)). Jul 1979. Contract EG-77-A-01-4077. 127p. Dep. NTIS, PC A07/MF A01.

A cooperative agreement was negotiated in April 1978 for the installation of a space and domestic hot water system at Southeast of Saline, Kansas Unified School District 306, Mentor, Kansas. The solar system was installed in a new building and was designed to provide 52 percent of the estimated annual space heating load and 84

percent of the estimated annual potable hot water requirement. The collectors are liquid flat plate. They are ground-mounted and cover a total area of 5125 square feet. The system will provide supplemental heat for the school's closed-loop water-to-air heat pump system and domestic hot water. The storage medium is water inside steel tanks with a capacity of 11,828 gallons for space heating and 1,600 gallons for domestic hot water. This final report, which describes in considerable detail the solar heating facility, contains detailed drawings of the completed system. The facility was declared operational in September 1978, and has functioned successfully since.

54430 (DOE/NASA/CR—161272) **Solar energy retrofit for Clarksville Middle School, Clarksville, Indiana. Final report.** (Clarksville Community School Corp., IN (USA)). Aug 1979. Contract EX-76-A-29-1037;EG-77-A-01-4076. 124p. Dep. NTIS, PC A06/MF A01.

This final report describes in detail the solar energy retrofit heating system installed to provide heating for two gymnasiums at the Clarksville Middle School located in Clarksville, Indiana. The solar components were partly funded by the Department of Energy, and the technical management was done by the Marshall Space Flight Center. The system type is hot water using existing chilled water piping and chilled water coils in an air handler system. Flat-plate, single-glazed selectively coated solar collectors were installed on the roof of each gymnasium. Total collector area covers 6,520 square feet. The liquid is stored in a 10,000 gallon steel tank installed below grade.

54431 (DOE/TIC—10385) **Solar heating and cooling of buildings (SHACOB) commercialization report: options and strategies. Part A. Volume II. Technical report. Final report.** (Midwest Research Inst., Kansas City, MO (USA); Federal Energy Administration, Washington, DC (USA)). 15 Jul 1977. 181p. Dep. NTIS, PC A09/MF A01.

The national and regional perspectives for SHACOB are presented. An overview is given of the participants in SHACOB commercialization. Economic, institutional, legal, and other barriers constraining commercialization are discussed. Various analytical models are examined which project the future extent of SHACOB use or market penetration and future SHACOB to US energy supplies under alternative government policies. The results for the baseline case (no further government action, of several market penetration models are presented. Possible ways to overcome each of the barriers are presented. Qualitative analyses are given for the various incentives. Each incentive is examined to assess its impact on barriers to SHACOB commercialization and its impact on various income and interest groups. Individual incentives are compared and combined into alternative policy strategies and options. (MHR)

54432 (DOE/TIC—10386) **Solar heating and cooling of buildings (SHACOB) commercialization report: options and strategies. Part A. Volume III. Appendices. Final report.** (Midwest Research Inst., Kansas City, MO (USA); Federal Energy Administration, Washington, DC (USA)). 15 Jul 1977. 168p. Dep. NTIS, PC A08/MF A01.

The following appendices are included: industry activities, solar commercialization activities at the state and local level, electric utility interface, description of the computer model, and comparison with other energy investments. (MHR)

54433 (DOE/TIC—10648) **Solar heating and cooling of buildings (SHACOB) commercialization report. Part B: analysis of market development. Volume III. Appendices. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Sep 1977. 59p. Dep. NTIS, PC A04/MF A01.

The appendices include documentation of the SHACOB Commercialization Model, the underlying Model assumptions and the resulting data base, and incentives. (MHR)

54434 (DOE/TIC—10744) **Solar heating and cooling of buildings (SHACOB) commercialization report. Part B: analysis of market development. Volume 1. Executive summary. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Sep 1977. 25p. Dep. NTIS, PC A02/MF A01.

The following are summarized: programs objective and scope, quantitative results, discussion of financial incentives, model philosophy and description, industry infrastructure, and market research. (MHR)

54435 (DSE—1020-T17) **First passive solar home awards.** (Franklin Research Center, Philadelphia, PA (USA)). Jan 1979. Contract EX-76-A-29-1020. 231p. Dep. NTIS, PC A07/MF A01.

The 162 projects included are divided into three general categories: direct solar gain, indirect solar gain, and solarium. In addition to project descriptions, general material is included on selecting the best type of solar project for a given area, issues involved in marketing passive solar homes, and calculating the solar gain from passive systems. (MHR)

54436 (LA-UR—79-2381) **LASL/UNM solar economic performance code: a basic primer.** Roach, F.; Ben-David, S.; Kirschner, C. (Los Alamos Scientific Lab., NM (USA); New Mexico Univ., Albuquerque (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791022—2). Dep. NTIS, PC A02/MF A01.

From 4. national passive solar energy conference; Kansas City, KS, USA (3 Oct 1979).

The LASL/UNM solar economic performance code (model) has been developed to assist in the evaluation of market potential for residential passive solar heating systems on a nationwide basis. Components of the model can be divided into three major categories: inputs, methodology, and output. Each of these categories are briefly described.

54437 (LA-UR—79-2382) **Passive solar, auxiliary heat, and building conservation optimization: a graphical analysis.** Noll, S.; Thayer, M. (Los Alamos Scientific Lab., NM (USA); Missouri Univ., Rolla (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-791022—1). Dep. NTIS, PC A02/MF A01.

From 4. national passive solar energy conference; Kansas City, KS, USA (3 Oct 1979).

A primary goal of energy conscious, climate adaptive building design is to reduce reliance on non-renewable fuel sources for heating, cooling, lighting, service hot water and ancillary electric requirements while providing acceptable or improved levels of occupant comfort. This paper addresses one aspect of overall building design optimization: that is, what combinations of passive solar heat gain, auxiliary heat, and building conservation level promote the most efficient use of scarce resources (monetary and/or primary energy). A review of recent methodological developments is given and a graphical analysis is presented for illustrative purposes.

54438 (MSSU-EIRS-GE—80-1) **Mid-south solar total energy institutional analysis. Semi-annual technical progress report, December 1978-May 1979.** Powe, R.E.; Carley, C.T.; Forbes, R.E.; Johnson, L.R. (Mississippi State Univ., Mississippi State (USA). Energy Research Center). 1979. Contract ET-78-S-05-5868. 165p. Dep. NTIS, PC A08/MF A01.

During this reporting period a variety of individual components likely to be employed in total energy systems at Mississippi State University have been considered in detail. Also, algorithms have been developed for the approximate prediction of building heating and cooling loads based on gross parameters such as floor area, type of wall construction, etc. A comprehensive survey was undertaken to determine the current usage of energy by the university and correlation equations were used to project consumption rates for the next few years. The development of an algorithm for heating and cooling load calculations is described. Design and specifications are given for a solar-assisted space heating system, a solar air conditioning system, and a 1-MWe solar thermal power plant for the university. Flat plate collectors for space heating or water heating at the MSU compus are assessed. Also the possibility of exploiting low-grade geothermal energy near MSU rising heat pumps for space heating is discussed.

54439 (NMEI—22-SA) **Design calculation procedure for passive solar houses. Semiannual report, September 1, 1978-April 22, 1979.** Lumsdaine, M. (New Mexico State Univ., Las Cruces (USA). Physical Science Lab.). Apr 1979. 64p. New Mexico Energy Inst., Las Cruces, NM.

A simple design procedure is presented intended for direct gain, Trombe wall (mass or water), solar roofs, and combinations of these for new buildings. The calculation procedure is divided into several steps with corresponding worksheets and supporting material. (MHR)

54440 **Solar heating system.** Powell, C.E. US Patent 4,088,115. 9 May 1978. Filed date 19 Aug 1976. 14p.

A solar heating system is disclosed including a large number of nested thin wall cylindrical collector-convertors disposed in vertical positions and housed within an insulated housing having a window therein to allow light rays from the sun to strike the collectors at any of different angles regardless of the latitude or altitude of the sun. Ultraviolet and other shorter wave length rays are converted into heat upon striking the inner surfaces of the collectors to heat the walls thereof, and infra-red and other longer wave length rays are absorbed by coatings on the collectors to likewise heat the walls thereof. Those rays which are reflected strike the opposite collector wall surfaces to again be converted to heat. The collectors are of such length as to enable multiple reflections under practically all conditions. Air to be heated is passed lengthwise along the outer wall surfaces of the collectors to pick up the heat therefrom and is then passed to a heat storage device under certain temperature conditions where it is stored for future use. The heat storage device is constructed of stacked cement plates having labyrinth passages therein through which the heated air is passed to heat the concrete. Air for heating a building or the like is passed through other labyrinth passages within the heat storage device to absorb heat therefrom. An automatically controlled valve system

controls the passage of heated air between the collector-converter housing, the heat storage device and a building structure to be heated in different manners depending upon the relative temperature conditions existing within the building, the collector-convertor unit and the heat storage device.

54441 (SAN—1439-2) **Analysis of advanced conceptual designs for single-family-size absorption chillers. Project 9101 final report, for the period September 1, 1977-August 31, 1978.** Macriss, R.A.; Cole, J.T.; Kouo, M.T.; Zawacki, T.S. (Institute of Gas Technology, Chicago, IL (USA)). Feb 1979. Contract EG-77-C-03-1439. 55p. Dep. NTIS, PC A04/MF A01.

This report presents the results of a research study to identify new and potentially improved fluid systems for solar-powered absorption cooling. The study included a thorough state-of-the-art review, screening of alternative candidates, data development of the most promising candidates, and cycle calculations to evaluate the best alternative systems. Both binary and ternary absorption systems have been addressed, systems exhibiting positive and negative deviation from Raoult's law were examined, and cycle calculations were performed for water- and air-cooled systems and input temperatures typical of low cost flat-plate collectors and higher temperature concentrating collector systems. Based on criteria established in this study, several binary and ternary systems have been identified as being potentially superior to the conventional systems for solar-powered absorption cooling.

54442 (SAN—1586-1) **Analysis of advanced conceptual designs for single-family-sized absorption chillers. Semi-annual report.** (Southern Research Inst., Birmingham, AL (USA)). 5 Apr 1978. Contract EG-77-C-03-1586. 86p. Dept. NTIS, PC A05/MF A01.

The objective of the research program is to develop and analyze new concepts for absorption cycles to improve the performance or reduce the cost (or both) of a 3-ton absorption chiller that can be used with solar-collected heat. New refrigerant-absorbent pairs, additives to currently used refrigerant-absorbent pairs, and modifications to the cycle are being investigated. For the initial analyses the use of a fluid at 160 to 230°F from a solar collector as a heating source is assumed. In the initial analyses the chiller is to provide chilled water at 45°F at full load; alternatively, if a new refrigerant-absorbent pair appears to be amenable for direct cooling of the occupied space, the temperature of the evaporator is to be 45°F. Both water cooling and air cooling of the absorber and the condenser are being studied. The use of ambient air at 95°F dry bulb and 75°F wet bulb temperatures is assumed. With the water-cooled cycles, the initial and operating costs of a properly sized cooling tower will be included. The research consists of five principal tasks: (a) acquisition of information for analysis, (b) definition of criteria for selection of promising refrigerant-absorbent pairs, additives for currently used pairs, or cycle modifications, (c) preparation and analysis of conceptual designs, (d) comparison and selection of the promising new systems that warrant further study, and (e) recommendations for further research for each promising new system. Progress on each of these tasks is described. (WHK)

54443 (SAND—79-1574C) **Performance of solar passive buildings.** Stromberg, R.P. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 20p. (CONF-790850—2). Dep. NTIS, PC A02/MF A01.

From 1. international symposium on non-conventional energy; Trieste, Italy (27 Aug 1979).

Portions of document are illegible.

Test data are presented for five different homes during the same winter days. Trombe wall, waterwall, greenhouse, and direct gain features of the buildings display their differing responses to the same climate conditions.

54444 Solar energy receptor apparatus. Lents, J.M.; Rhodes, B.V. Sr. US Patent 4,148,293. 10 Apr 1979. Filed date 4 Apr 1977. 12p.

A solar heating system operating on a phase-change cycle and suitable for operation in buildings is disclosed. A solar heating panel is positioned to receive solar energy, and fluid passages within the panel are connected in a sealed closed fluid system. The closed fluid system is charged with a fluid medium which is vaporized by solar heating occurring in the solar panel. The heated vaporized fluid flows through energy extraction devices which do work while utilizing energy extracted from the vapor. The vaporized fluid flows to a condensor in heat exchange relation with a heat storage medium, such as a tank of water. The heat of vaporization given out by the condensing vapor is supplied to the heat storage medium, and heat can then be withdrawn from storage for space heating or for other purposes. The solar heating panel can be a composite structure fabricated from rolled sheet metal, which provides a substantial reduction in unit cost of the heating panel. The solar heating panel can also be used to provide direct heating of air.

54445 Solar-exothermic solution heat pump. Foulke, W.B. US Patent 4,146,013. 27 Mar 1979. Filed date 4 May 1977. 8p.

A novel heat pump using solar energy and the heat of dilution of exothermic inorganic salts and organic compounds is disclosed. The heat pump is made up of four parts including a solar energy absorbing surface, a means for diluting the concentrated solution, and heat exchange apparatus to take the heat of dilution and distribute it to the space to be heated.

54446 Passive solar heating of buildings. Balcomb, J.D.; Hedstrom, J.C.; McFarland, R.D. (Los Alamos Scientific Lab., NM). pp 123-155 of Energy from the sun. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from the sun; Chicago, IL, USA (3 Apr 1978).

Passive solar heating concepts - in which the thermal energy flow is by natural means - are described according to five general classifications: direct gain, thermal storage wall, solar greenhouses, roof ponds, and convective loops. Examples of each are discussed. Passive test rooms built at Los Alamos are described and results are presented. Mathematical simulation techniques based on thermal network analysis are given together with validation comparisons against test room data. Systems analysis results for 29 climates are presented showing that the concepts should have wide applicability for solar heating.

54447 Performance of solar heating and cooling systems. Peuser, F.A. (ed.). Duesseldorf, Germany; Verein Deutscher Ingenieure (1978). 373p. (CCMS—85; CONF-7804101—P2). International Solar Energy Society, c/o VDI-GET, P.O. Box 1139, 4000 Duesseldorf, Germany.

From CCMS meeting; Dusseldorf, F.R. Germany (19 Apr 1978).

Separate abstracts were entered into the data base for each of the 20 included papers. (MOW)

54448 Air conditioning system having compressor-expander in pressurized closed loop system with solar assist and thermal storage. Edwards, T.C.; Ecker, A.L. (to Rovac Corp.). US Patent 4,064,705. 27 Dec 1977. Filed date 26 Oct 1976. 22p.

An air conditioning system is disclosed for an enclosed space, capable of operating as a heat pump in the winter and as a refrigerator in the summer, of the type employing a unitary compressor and expander having a common rotor with vanes defining enclosed compartments for positive compression and expansion of air. An indoor heat exchanger and outdoor heat exchanger are provided with one being connected between the outlet port of the compresser and the inlet part of the expander and the other being connected from the outlet port of the expander to the inlet port of the compressor thereby to complete a loop which is charged with air. Valves are interposed for effectively interchanging the connections of the heat exchangers so that the indoor heat exchanger is used for warming in winter and cooling in summer. The outdoor heat exchanger is in the form of a solar-directed panel having a heat absorption surface and air passages for convection cooling. Means are provided for exposing the heat absorption surface and closing the air passages in the winter and for shielding the absorption surface and opening the air passages in the summer. A cold storage device is provided to serve as a heat source and to freeze water during the winter and with the melting of the resulting ice augmenting cooling effect during the summer. A heat storage device is also used to store heat during a winter day for release during the winter night. The loop is pressurized with air, the pressure being correctively varied by thermostatic control to vary the heat rate, thereby to maintain a set temperature both winter and summer in the enclosed space. The air in the loop is preferably moistened and a regenerator is optionally provided to increase the capacity of the system under extreme temperature conditions.

54449 Potential for solar heating in Canada. Hollands, K.G.T.; Orgill, J.F. Waterloo, Ontario; Univ. of Waterloo (1977). 109p. $3.50.

The feasibility of solar heating of buildings in Canada is examined by simulating the performance of solar heating systems on a computer and evaluating the relevant economic parameters. Computer simulations were carried out for seven representative Canadian cities, five different types of buildings to be heated, and three types of solar system designs. Twenty year life cycle cost comparisons were made with oil and electricity, based on several assumed scenarios for their future prices. Results of the study show that the dependence of solar heating unit cost on the city chosen is slight; the dependence on the building type chosen is substantial, with multi-family dwellings showing the least cost. Solar heating was found to be cost-effective in 1976 for some of the scenarios for future oil and electricity prices assumed, and for some building types and some cities. The cost-effectiveness of solar heating is predicted to be improved by 1980.

54450 Heat transfer in solar energy systems. Howell, J.R.; Min, T. (eds.). New York, NY; American Society of Mechanical Engineers (1977). 139p. (CONF-771120—P5).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Nov 1977).

Separate abstracts were prepared for 12 of the 15 papers presented. Three papers were previously included in the data base. (WHK)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 55592

54451 (CONF-7805129—) **Solar grain drying conference proceedings.** Hartsock, J.G. (ed.). (Purdue Univ., Lafayette, IN (USA). Agricultural Experiment Station; Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications; Science and Education Administration, Washington, DC (USA)). 1978. Contract EX-76-A-29-1032. 153p. Dep. NTIS, PC A08/MF A01.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Sixteen papers are included on solar grain drying. Separate abstracts were prepared for each paper. (MHR)

54452 (CONF-7805129—, pp 1-3) **Solar energy for grain drying.** Foster, G.H.; Peart, R.M. (Purdue Univ., West Lafayette, IN). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

The history, characteristics, and research needs in solar energy for grain drying are reviewed briefly. (MHR)

54453 (CONF-7805129—, pp 5-9) **Rice drying with immediately applied and stored solar heat.** Calderwood, D.L. (USDA, SEA, Federal Research, Beaumont, TX). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

The objective of 1977 solar rice drying tests was to determine the suitability of a pebble-bed as a heat storage medium. Items taken into consideration are the construction cost and resistance to air flow of a pebble-bed heat storage unit, the amount of heat collected by solar collectors and a comparison of drying times, electric energy used and milling yields of rice dried with unheated air, with immediately applied solar heated air and with air heated after the time of collection by stored solar heat. A pebble-bed solar heat storage unit did not justify its construction costs under the conditions of these tests. Faster drying with stored solar heat, as compared with immediately used solar heat, is attributed to the large size solar collector used for heating the pebble-bed. The milling yields of rice did not appear to be affected by the drying treatments.

54454 (CONF-7805129—, pp 13-28) **Solar grain drying for Ohio.** Misra, R.N.; Keener, H.M. (Ohio Agricultural Research and Development Center, Wooster). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Research in progress on instantaneous collection using the SOLORON collector, and storing solar heat in water by a high temperature SUNPAK collector, and by a solar pond is reviewed. (MHR)

54455 (CONF-7805129—, pp 29-35) **Solar energy collection and storage for grain drying at high temperatures.** Parker, B.F.; White, G.M.; Loewer, O.J. Jr. (Univ. of Kentucky, Lexington). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

High-temperature heat from a focusing solar collector is considered as an alternative to fossil fuels in heating and drying air. A sun-tracking focusing solar collector for heating air to temperatures between 250 and 350 F has been constructed and installed. Limited operation of the collector indicates efficiencies between 30 and 50% at outlet temperatures between 250 and 320 F. The use of crushed rock as a heat storage medium has been studied. Data from seven rock bed units show that the pressure drop due to air flow and the rate of heat transfer between the heated air and the stone can be predicted using data from the literature for flow through porous media. For accurate predictions the limestone should be of uniform size. A small grain bin has been constructed to utilize the heat energy stored in the rock bed units. Three of the 1150-pound rock bed units will be utilized at once to provide heat for drying a 9-bushel batch of grain. Operation of the collector, rock storage, and the grain drying processes have been individually simulated on the computer. An economic feasibility study has also been individually simulated on the computer. An economic feasibility study has also been carried out using a range of solar system costs, fuel costs, and interest rates. At today's fuel prices, high-temperature solar grain drying cannot economically compete with LP Gas; however, technological improvements, higher prices for fossil fuel and multiple use of the solar system as a farmstead heat energy system might well make such a system feasible in the future.

54456 (CONF-7805129—, pp 37-55) **Solar regeneration of silica gel and use in grain drying.** Aldis, D.F.; Burroughs, R.; Hughes, J.W. (Dept. of Agriculture, Manhattan, KS). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Silica gel was used to store solar energy for drying corn and milo. Three 277 kg lots of silica gel, 26% dry basis moisture content, were regenerated with solar energy for two days crior to and during the drying tests. A 1520 kg lot of corn, 23.5% wet basis moisture content and 0.66 m deep, was dried until the moisture content of the surface of the corn in the bin was below 15% wet basis with a 40:60 mixture of ambient and desiccated air in 280 hours. A duplicate lot (with a moisture content of 24.2% wet basis), dried simultaneously with ambient air alone, required 350 hours. The final average moisture contents of the two lots were 12.0 and 12.5% wet basis, respectively. Mold counts and aflatoxin concentrations were significantly lower in corn dried with the mixture of ambient and desiccated air. No significant difference in susceptibility to breakage attributable to drying method was found between the two lots. Two 1520 kg lots of milo, 18.5% wet basis moisture content and 0.53 m deep, were dried with the same airflow rate until the surface moisture content was below 16.2% wet basis. Drying required 210 hours with 60:40 mixture of ambient and desiccated air and 330 hours with ambient air. Final average moisture contents were 12.6% and 14.4% wet basis, respectively.

54457 (CONF-7805129—, pp 57-60) **Solar corn drying with a combination desiccant/low-temperature system.** Bern, C.J.; Anderson, M.E.; Wilcke, W.F. (Iowa State Univ., Ames). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

The annual use period of a solar collector on a conventional low-temperature drying system is typically 30 to 60 days. If the collector is not used for another purpose, it is idle for the rest of the year. This paper reports results of a field study of a system that prolongs the use period of the solar collector to as long as 6 months and stores solar heat in the form of drying capacity in overdried corn. Heat from a solar collector is used to overdry corn for later use as a desiccant to be mixed with wet corn at harvest.

54458 (CONF-7805129—, pp 71-82) **Solar grain drying under hot and humid conditions.** Chau, K.V.; Baird, C.D.; Bagnall, L.O. (Univ. of Florida, Gainesville). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Due to the humidity and ambient temperature of the South, aflatoxin contamination of feed grain is of grave concern. Problems involved in solar grain drying without aflatoxin production are explored. The development of a low-cost solar air heater suited for crop drying and similar applications is reviewed. (MHR)

54459 (CONF-7805129—, pp 83-90) **Solar collectors for low temperature grain drying.** Kline, G.L. (Iowa State Univ., Ames). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Solar energy collectors of various types were investigated for use in drying grain. The performance of 12 different solar collectors is reported.

54460 (CONF-7805129—, pp 91-97) **Inflated plastic structures for solar drying of grain.** Buker, R.J. 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

A solar grain dryer was designed that required $756.22 to build and operate. The grain dried in it suffered some damage, but sold for $2,755.00 more than it would have at harvest for a return to design, labor and management of almost $2,000.00. Had it been sold in January before the damage occurred, it would have sold for about $800.00 less. The labor required to load the grain out of the dryer is partly offset by not having to rehandle grain from the combine at harvest time when labor and trucks are in short supply.

54461 (CONF-7805129—, pp 99-103) **Drying grain with air from a solar heater designed for animal shelters.** Lipper, R.; Anschutz, J.; Spillman, C.K. (Kansas State Univ., Manhattan). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

The farrowing house solar collector-storage wall is described. The feasibility of using this wall for heat collection for grain drying is explored and the combination use found to be nearly ideal. (MHR)

54462 (CONF-7805129—, pp 105-109) **Solar collectors incorporated into agricultural buildings to collect energy for crop drying.** Shove, G.C. (Univ. of Illinois, Urbana). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Agricultural buildings provide large areas of flat surfaces into which solar energy collectors can be incorporated. Walls and roofs

constructed as flat plate collectors with only minor modification in building design help reduce collector costs. Air is utilized as the heat transfer medium since agricultural crop drying is accomplished by moving air though wet grains and forages. Solar collectors on buildings are efficient, even through various air cavities are utilized, because the high airflows used in crop drying result in relatively high air velocities and small temperature differentials. In some situations the collectors can have a multiple use such as heating a repair shop or livestock shelter after the crop drying season. Therefore, the inclusion of collectors to collect solar energy for farmstead operations should be given serious consideration as existing buildings are remodeled or new buildings planned.

54463 (CONF-7805129—, pp 111-118) **Low temperature, low air flow solar drying of corn with and without stirring.** Baker, K.D.; Foster, G.H. (Purdue Univ., W. Lafayette, IN). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Solar drying for the low temperature phase of a combination high temperature-low temperature drying system appears feasible with reduced air flow rates. Since the air flow is reduced, continuous stirring of the grain is undesirable; however, with proper management, a stirring auger may be beneficial.

54464 (CONF-7805129—, pp 119-134) **Solar and natural air grain dryer performance in the corn producing areas of the US - simulation results.** Thompson, T.L.; Pierce, R.O. (Univ. of Nebraska, Lincoln). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

A detailed computer simulation study by Pierce and Thompson (1976) evaluated the effect of solar grain drying for the North Central Region of the United States. The drying results presented here represent an expansion of this simulation study to some of the warmer, more humid corn producing areas of the United States and a more detailed evaluation of various management strategies for different climatic regions. This paper is a continuation of the North Central Region study, and thus includes a summarization of that project.

54465 (CONF-7805129—, pp 135-136) **Solar energy applications to crop drying.** Butler, J.L. (Coastal Plain Experiment Station, Tifton, GA). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

This research program, funded in part by DOE, for the application of solar energy to the drying of crops other than grain, consists of eight project locations which are described briefly. Tobacco curing, which is second only to grain in fuel requirements for drying, is being investigated at three locations, peanut and forage curing are being investigaated at two locations each, and the development of low-cost collector-storage systems designed specifically for agricultural use is being conducted at one location. Although these projects may be currently concentrating on a specific application, all are aware that additional uses of the collector-storage system will reduce the cost of solar energy drying and speed its adoption.

54466 (CONF-7805129—, pp 137-150) **Wheat-drying costs for solar and alternative drying systems.** Haas, M.L.; Barrett, J.R.; Tyner W.E. (Purdue Univ., W. Lafayette, IN). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

Fixed and variable in-bin wheat drying costs are developed and presented using information from on-farm research experience and present construction and materials cost. The effects of larger bin diameters and capacities, along with the effects of equipment purchased for the sole use of drying wheat are considered. Cost differences attributed to alternative heat sources are included with emphasis on low energy solar and natural unheated air systems in contrast to liquid petroleum (LP) gas systems. This paper is arranged in three sections, the first is on fixed costs, the second is on variable drying costs under both present and increased energy prices, and the third section presents the maximum price that can be competitively paid for a solar collector.

54467 (DOE/ERD—0025) **Environmental Readiness Document: solar agriculture and industrial process heat.** (Department of Energy, Washington, DC (USA)). Aug 1979. 19p. Dep. NTIS, PC A02/MF A01.

The uncertainties about environmental aspects of solar agricultural and industrial process heat (SAIPH) that remain to be resolved through research and development are examined. The characteristics of the technology are highlighted, a status report is provided on the technical and environmental R and D programs, a milestone chart is presented representing a relationship between a considered commercialization schedule and relevant environmental R and D, and the environmental concerns significant to the technology are reviewed. The likelihood and consequences of adverse findings, the problems and uncertainties stemming from current or anticipated environmental regulation, and the potential costs of environmental controls are examined. As assessment of the existing or potential barriers to commercialization is made. A summary of present, planned, and additional environmental resource requirements for SAIPH is included. (MHR)

54468 (SERI/TP—39-240) **State-of-the-art of solar control systems in industrial process heat applications.** Su, W.S.; Castle, J.N. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 25p. (CONF-791005—5). Dep. NTIS, PC A02/MF A01.

From ISA national conference; Chicago, IL, USA (22 Oct 1979).

The state-of-the-art of solar control systems is addressed pertinent to industrial process heat applications. Solar system configurations currently being used or proposed are presented; parameters and functions deemed essential in solar system controls are identified; operating deficiencies are described; and possible future improvements are discussed.

WATER HEATING

REFER ALSO TO CITATION(S) 54426, 54428, 54429, 54438, 54450

54469 (COO—4675-T1) **Woodstock Resort Corporation solar hot water program. Final report.** (Rockresorts, Inc., Woodstock, VT (USA)). 30 Mar 1979. Contract EW-78-G-02-4675. 6p. Dep. NTIS, PC A02/MF A01.

Two major solar arrays each containing 120 Revere tube-in-strip double glazed solar collector panels are included. Photographs and a small amount of performance and financial data are included. (MHR)

54470 **Multi-family solar water heating: design choices, retrofit case study, municipal solar utility approach. Final report.** San Diego, CA; Southwest Energy Management, Inc. (1978). 130p. (NP—23870). The Publisher, 7283 Engineer Road, Suite G, San Diego, CA.

Background information is presented concerning the various types of solar systems commercially available to multi-family complexes. The specific options available for retrofit in the Friars Village condominiums are discussed more thoroughly. The municipal solar utility approach is presented as it represents relief to consumers for design, procurement, installation, maintenance, and financing decisions and responsibilities. (MHR)

OTHER

54471 (NMEI—31) **Solar powered agricultural irrigation pumping. Technical report, 1 June, 1976-28 February, 1979.** Abernathy, G.H.; Mancini, T.R. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Feb 1979. 28p. New Mexico Energy Inst., P.O. Box 3EI, Las Cruces, New Mexico.

A solar-powered irrigation pumping system was designed and installed at Willard, New Mexico. The system incorporated an east-west oriented field of parabolic trough solar collectors to heat oil. The hot oil in turn heated freon which drove a high-speed turbine connected to the irrigation pump. Design of the system has been completed and all components have been installed and are operative at this time. Technical delays prevented the collection of operation and maintenance data to date, but under a new contract with Sandia Laboratories it is expected that this will be accomplished during the 1979 irrigation season. In conjunction with the solar pump, agricultural experiments were conducted by New Mexico State University. These included drip irrigation of typical food crops that could be grown in the area. Using drip irrigation, yields were 10 to 15 percent greater than would be expected on typical farms in the Estancia area. Water use was about one-half that needed with the normal flood system of irrigation.

54472 **Solar motor.** Schmidt, G.A. US Patent 4,165,734. 28 Aug 1979. Priority date 25 Jun 1976, German, Federal Republic of (F.R. Germany), 2p.

A steam generator derives solar energy by means of a plastic Fresnel lens mounted in a movable framework to follow the sun by means of a manually movable mechanism attached to the steam generator housing.

54473 **Solar powered engine and tracking system.** Chromie, E. US Patent 4,144,716. 20 Mar 1979. Filed date 26 Oct 1976. 8p.

A solar powered engine and tracking system comprises a piston working within a cylinder for turning a drive shaft for driving an electrical generator or performing other useful work, a solar concentrator comprising a plurality of mirrors, each reflecting sunlight on a common focal point on the end of the cylinder for heating a flash boiler located thereon, preheated water from a source is injected into the flash boiler by a pump powered by the drive shaft

timed according to piston movement after operating the piston, the steam is then vented from the boiler by valve means operated from the drive shaft. A starter motor is provided to initially start the engine operating by rotating the drive shaft until the piston movement is self sustaining. The entire device is enclosed in a solar energy collector panel for elevating the temperature of the system so as to maintain the water at a sufficient temperature with a minimum of external heating. The collector may also be utilized for separate external heating purposes. Sensor controlled motors track the relative movement of the sun and earth and continually position the collector for maximum solar energy concentration.

54474 Solar vaporizing chamber. Brown, D.R. US Patent 4,142,512. 6 Mar 1979. Filed date 12 Oct 1976. 6p.

The present invention consists of a novel solar liquid vaporizing chamber for receiving liquids for vaporization. Hot vapors are released from the chamber and piped to desired locations while additional liquids are introduced into the chamber for vaporization.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 54369, 54390, 54432, 54450, 54454, 54459, 54462, 54472

54475 (DOE/ET/21068—T1) **Assistance to small businesses in international market development for solar thermal technology. Final technical report, 15 April 1979-15 July 1979.** Walton, J.D. Jr. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). Jun 1979. Contract FG05-79ET21068. 7p. Dep. NTIS, PC A02/MF A01.

Grants were awarded to eight manufacturers of concentrating solar thermal collector systems. These grants were for the purpose of assisting small businesses in exhibiting solar thermal systems at the 1979 International Congress of the International Solar Energy Society (ISES).

54476 (DOE/NASA/CR—161164) **Certification and verification for Northrup Model NSC-01-0732 Fresnel lens concentrating solar collector.** (Northrup, Inc., Hutchins, TX (USA)). Mar 1979. Contract EX-76-A-29-1037. 182p. Dep. NTIS, PC A09/MF A01.

The certification and verification of the Northrup Model NSC-01-0732 Fresnel lens tracking solar collector are presented. A certification statement is included with signatures and a separate report on the structural analysis of the collector system. System verification against the Interim Performance Criteria are indicated by matrices with verification discussion, analysis, and enclosed test results.

54477 (DOE/NASA/CR—161290) **Development of surfaces optically suitable for flat solar panels. Final report.** (Alabama Univ., University (USA). Dept. of Physics and Astronomy). Aug 1979. Contract EX-76-A-29-1037;EG-77-S-05-5362. 45p. Dep. NTIS, PC A03/MF A01.

This final report contains three principal items. The first describes a simple and novel reflectometer which can separately evaluate the spectral and diffuse reflectivities of surfaces. A phase locked detection system for the reflectometer is also described. The second item is a selective coating on aluminium potentially useful for flat-plate solar collector applications. The coating is composed of strongly bound copper oxide (divalent) and is formed by an etching process performed on an aluminium alloy with high copper content. Because of this one step fabrication process, fabrication costs are expected to be small. Process parameters, however, need further definition. The third item contains conclusions gleaned from the literature as to the required optical properties of flat plate solar collectors.

54478 (LBL—8632(Rev.)) **Microstructure and optical properties of black chrome before and after exposure to high temperatures.** Lampert, C.M.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 15p. (CONF-790120—2(Rev.)). Dep. NTIS, PC A02/MF A01.

From 2. annual conference on absorber surfaces for solar receivers; Boulder, CO, USA (24 Jan 1979).

The chemical and microstructural stability of the CHROMONYX type of black chrome solar coating was investigated at different temperatures and atmospheres. This was done to give a better understanding of the mechanism of solar energy selectivity and its variability when subjected to short term heat treatments. The as-plated structure was found to consist of a suspension of metallic chromium particles within the size range of 100A in an amorphous oxide matrix. This assembly was in turn formed into larger particles within the size range of 0.05-0.30 microns. Short term high temperature heat treatments were used to simulate stagnation conditions. Samples were annealed in both air and vacuum, which resulted in similar characteristics. Annealing in air appeared to mildly accelerate optical degradation at high temperatures. For short term heat treatments below 300°C the reflective and microstructural properties appeared to be unchanged. By in situ vacuum annealing of the coating above 400°C microcrystalline Cr_2O_3 was identified. By observation of diffraction patterns it was concluded that a-Cr_2O_3 was transformed into crystalline Cr_2O_3. The Cr_2O_3 phase continued to grow at higher temperatures at the expense of chromium content. At temperatures above 500°C in vacuum, a new phase identified as $NiCr_2O_4$ formed. It was found that black chrome failed optically between 500-600°C for 1 hour heat treatments in both air and vacuum; also the coating heated in air failed mechanically by peeling at 600°C.

54479 (LBL—9324) **Metal foils for direct application of absorber coatings on solar collectors.** Lampert, C.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 18p. (CONF-791021—1). Dep. NTIS, PC A02/MF A01.

From 2. American Electroplaters Society symposium on coatings for solar collectors; St Louis, MO, USA (16 Oct 1979).

The basic materials and processing associated with the production of coated metal foils for solar collector absorber surfaces are discussed. Also covered are details of heavier metal strips for direct fabrication of solar collectors. Techniques including bonding methods and the use of adhesives are surveyed. Commercial solar foil manufacturers are covered, along with the new research efforts in this area. In conclusion, advantages and disadvantages are outlined, with specific recommendations.

54480 (SAND—79-0658) **Summary report: Suntec Solar Linear Array Thermal System (SLATS) test results.** Gerwin, H.J. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 58p. Dep. NTIS, PC A04/MF A01.

A fixed-receiver, movable-reflector solar collector system built by Suntec Systems, Inc., has been tested at the DOE/Sandia Midtemperature Solar Systems Test Facility near Albuquerque, NM. The collector included 260 m^2 of reflector area. Thermal energy was transferred from the linear receiver to a heat exchanger by water and from the heat exchanger to the thermal storage tanks by Therminol 66 (T-66). The collector system start-up and operation over a period of 16 months is described. Several data tables and many graphical displays show the performance characteristics under various operating parameters.

54481 (SAND—79-1026) **Receiver assembly design studies for 2-m 90° parabolic-cylindrical solar collectors.** Ratzel, A.C. (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 90p. Dep. NTIS, PC A05/MF A01.

Results are presented from a parametric study of the Sandia Laboratories' second-generation 2-m, 90° parabolic-cylindrical solar collector design. A computer simulation was developed to provide cumulative all-day performance results or instantaneous solar-noon results for three annular solar receiver assemblies: 2.223-, 2.54-, and 3.175-cm-o.d. tubes with concentric glass jackets. Representative clear spring, summer, and winter conditions for Albuquerque, NM, were modeled. Design problems considered in the analysis included misalignment of the receiver assembly from the focal line, reflector trough tracking bias, variation in receiver tube operating temperature, and variation in the reflector trough one-dimensional slope errors and two-dimensional mirror errors. Changes in collector material radiative properties and wind effects are also summarized, and comparative performance results for evacuated versus nonevacuated annular receivers are given. Summarized performance results for all studies are provided graphically. For operating receiver-tube temperatures < 475 K, the 3.175-cm receiver tube provides the best overall collector performance results. For higher operating temperatures where detrimental receiver heat losses become more significant, the smaller 2.54-cm tube is more effective for solar energy collection.

54482 (SAND—79-1378C) **Performance of linear solar concentrating collectors.** Stromberg, R.P. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 21p. (CONF-790850—1). Dep. NTIS, PC A02/MF A01.

From 1. international symposium on non-conventional energy; Trieste, Italy (27 Aug 1979).

Performance equations and performance as a function of intensity are discussed. Progress over the past five years and current linear concentrating collector performance are reviewed. The design and development of a low technology linear concentrator are described. (MHR)

54483 (SAND—79-7024) **Segmented dish concentrator design project.** Call, R.L. (Arizona Univ., Tucson (USA). Dept. of Electrical Engineering). Jul 1979. Contract EY-76-C-04-0789. 89p. Dep. NTIS, PC A05/MF A01.

The module uses a non-imaging thermoformed reflector consisting of tiers of conical reflecting surfaces sealed to a curved window which seals the mirror surfaces and the solar cells from the environment. A reflective coating is applied after the module is formed to the inside of the curved surfaces. Coatings of aluminum,

silver, and copper were used. The receiver is a hexagonal prism machined on the surface of a metal pipe with the hexagonal shape around the circumference. The receiver holds 18, 2x2 cm. 40X solar cells. Three cells are mounted on each face of the six faces and can be wired in series or series-parallel. The cells are individually soldered to molybdenum with a tab for the back electrical connection. The molybdenum-solar cell combination is mounted to the heat sink with silicon rubber impregnated with powdered silicon. This provides an electrically insulating medium with reasonable thermally conductive properties. The hexagonal heat sink is inserted into the module from the rear, extending far enough into the module to intercept the light reflected from the conical tiers. Each tier illuminates the entire cell surface with the 5 tiers adding together to yield 40X concentration. Water flows inside the heat sink to dissipate the heat generated by the module. Electrical leads, water lines, and thermocouple wires are fed through the back and sealed to prevent environmental interference with the inner surfaces of the module. The module was tested at The University of Arizona. For the silver coated module, an overall efficiency of 7.6% was obtained with an input of 346 watts. Solar cell surface temperature was 50°C. The cells were wired in series-parallel and a V/sub oc/ = 4 volts and an I/sub sc/ = 9.2 A was obtained. Four modules were delivered to Sandia in March 1979.

54484 Mounting bracket for solar heat collector. Brandt, R.F. US Patent 4,165,853. 28 Aug 1979. Filed date 16 Jan 1978. 4p.

Apparatus is described for mounting a solar collector to a mounting surface which permits the solar collector to maintain a predetermined orientation with respect to the position of the sun notwithstanding variation in slope and orientation of the mounting surface.

54485 Nonimaging radiant energy collector and concentrator. Ma, H.Z. US Patent 4,162,824. 31 Jul 1979. Filed date 30 Jun 1978. 8p.

A collector and concentrator of the nonimaging type for radiant energy, and particularly for solar energy, which includes a plurality of longitudinally-extending, generally trough-shaped channels having curved facing, reflective walls is described. The upper extremity of the channel defines an entrance aperture and the lower extremity defines an exit aperture. The walls are constructed of rectangular, flexible and deformable sheets or vanes attached along one edge to a longitudinal frame member having surfaces which are sloped to reflect a selected collector angle at the exit aperture and which are deformed by being urged against one another along the edge opposite to the attached edge. A radiant energy utilization means is disposed in the exit aperture.

54486 Method of fabricating a solar absorber panel. Severson, A.M. (to Honeywell Inc.). US Patent 4,161,809. 24 Jul 1979. Filed date 26 Sep 1977. 4p.

A method of making a solar absorber panel is disclosed in which mild steel sheets are provided with a pattern of recesses such that when the sheets are superimposed, an internal hollow fluid heat transfer passage system is formed thereby including inlet and outlet manifolds joined by connecting passages. A metallic sealing material having a lower melting point than the sheets is placed in the recesses, the sheets are superimposed and the structure is peripherally welded to form a gas-tight envelope. The envelope is purged of air, partially internally evacuated and the edges of the internal passages sealed by heating the assembly above the melting point of the sealant material. The vacuum drawn on the envelope insures a tight seal between all passages as it allows external ambient air pressure to force the sheets together. The sealant material, which may be copper brazing rod or other material should be one which imparts a corrosion-free coated surface to the passages in addition to providing a tight seal to the unit.

54487 Inflatable slar heat collector. Brindle, D.K.; Shanfelt, D.Y. US Patent 4,160,443. 10 Jul 1979. Filed date 21 Jul 1977. 6p.

An elongated inflatable tubular housing is provided including front and rear wall portions. The front wall portion is constructed of solar radiation transparent material and a panel of solar radiation absorbing material is mounted in the housing and extends between opposite sides thereof dividing the interior of the housing into front and rear compartments between the panel and the front and rear walls, respectively. Air inlet structure is operative to introduce air to be heated into the front compartment at one end of the housing, air pass structure is provided and operative to pass air from the front compartment into the rear compartment at the other end of the housing and air outlet structure is provided and operative to exhaust heated air from the rear compartment. The air inlet structure and air outlet structure include structures for conveying air from the interior of an enclosure to be heated into the front chamber and from the rear chamber back into the enclosure to be heated.

54488 Solar energy collectors. Spitzer, H.J. US Patent 4,158,355. 19 Jun 1979. Filed date 14 Oct 1976. 8p.

This invention utilizes a solar radiation absorbing fluid (i.e.: a black fluid) for direct solar energy to thermal energy transfer. The unique structure of the several disclosed embodiments of this invention provides for a selected distribution and a selected depth of the absorbing fluid in the solar energy exposed area. The disclosed apparatus converts solar radiation energy into thermal energy with higher conversion efficiency, lower material and manufacturing costs and considerable weight reduction compared to conventional solar collectors.

54489 Solar energy collection system. Carden, P.O. (to Energy Research Foundation). US Patent 4,158,354. 19 Jun 1979. Filed date 23 May 1977. 16p.

A solar energy collection system utilizing a fluid which dissociates endothermically and recombines exothermically is described. The preferred fluid is ammonia. Solar radiation is focussed onto absorber-reaction vessels from many paraboloidal mirrors. Means for electronically controlling the orientation of the mirrors is described. The mirrors may close together to reduce the effects to adverse climatic conditions.

54490 Solar collector. Lewis, R.H. Sr. (to Hawthorne Industries, Inc.). US Patent 4,156,419. 29 May 1979. Filed date 11 Jun 1976. 4p.

A flat plate collector is disclosed of parallelepipedal configuration for a solar energy system, comprising a plane collective surface for the reception of solar energy with internal channels designed to maximize turbulent flow of heat-absorptive fluid therethrough and provide a maximum of heat absorptive surface in proportion to the volume of fluid content. As designed, the collector is adaptable to mass, low-cost production.

54491 Flat-plate solar collector with air flowing through the grooves in a foam absorber surface. Loth, J.L. US Patent 4,154,220. 15 May 1979. Filed date 21 Mar 1977. 6p.

This invention relates to a more cost effective construction of an air type flat-plate solar collector. More particularly the invention has reference to replacing the usual combination of insulation backing and a good thermally conducting metal black absorber surface by a single, specially grooved and blackened, foam insulation type absorber surface. The airstream flows mainly inside the grooves to minimize its contact with the transparent cover. This new configuration saves weight, materials and cost, and shows little or no loss in performance during steady state efficiency tests. Due to the low thermal capacity of the foam absorber surface the collector warms up very quickly and often the internal thermal switch will actuate the fan motor within five minutes after exposure to solar radiation. This low time lag allows it to collect more heat during a day with intermittent sunshine than a collector with identical efficiency but with a metal abosrber of greater thermal capacity which takes longer to warm up.

54492 Solar collector module and solar collector system. Isaacson, B. US Patent 4,153,037. 8 May 1979. Filed date 21 Jul 1977. 6p.

The invention is directed to an easily fabricated, light-weight, solar collector module, and to a system for employing a plurality of said solar collector modules to achieve an efficient, relatively low cost method and means of collecting solar energy. The solar collector system comprises, preferably, a plurality of the light-weight, easily portable, module units which may be affixed to the roof of a house or other structure, in shingled fashion. Each of the modular units comprises, preferably, a pair of small-sized rectangular glass, or plastic, plates maintained in an offset, spaced relationship one above the other, by relatively small, glass, spacer support means. The normally upper surface of the lower plate of the unit is provided with a plurality of parallel grooves over a major portion of its surface. A plurality of such modular units are placed onto the roof of a structure, and rendered fluid-tight with respect to each other. The parallel grooves form a plurality of substantially continuous parallel fluid-carrying channels commencing from an upper entrance area and terminating in a lower exiting area. Fluid, which may be water or air, is pumped through the continuous space formed between the modular units and, is efficiently heated by the solar energy impinging upon the modular units.

54493 Solar energy collector. Wilson, W.W. (to Suntron Energy Systems Ltd.). US Patent 4,151,829. 1 May 1979. Filed date 21 Sep 1977. 6p.

A solar energy collector includes a housing having a back reflective wall and a transparent forward wall. The chamber between the walls is sealed against air-interchange with the surrounding air. A number of parallel blackened pipes are interconnected to define a fluid path from an inlet to an outlet, and the pipes are spaced so that there exists a plurality of unhindered light paths through the area of pipes from the transparent wall to the reflective surface, so that a substantial portion of any light passing along the unhindered paths and reflecting from the reflective surface will strike the exteriors of the pipes.

54494 Solar collector. Bowen, R.F. (to Raytheon Co.). US Patent 4,150,657. 24 Apr 1979. Filed date 21 Nov 1977. 4p.

A solar collector is disclosed which includes a radiation-absorbing panel having a surface provided with integral fluid-conducting conduits whereby heat absorbed by the panel may be efficiently transferred directly to fluid circulating in the conduits.

54495 Apparatus for preventing high temperatures in a glazed solar collector. Buckley, B.S. US Patent 4,150,659. 24 Apr 1979. Filed date 1 Apr 1977. 4p.

Venting the glazing (i.e., transparent cover) of a solar collector can be used to prevent the collector's absorber surface from reaching too high a temperature.

54496 Solar energy structure. Summers, V.R. US Patent 4,150,662. 24 Apr 1979. Filed date 10 Jun 1977. 8p.

A solar energy reflecting and collection structure is disclosed for effecting improved energy recovery in solar collection systems. The reflecting structure includes cavities or depressions of parabolic character and, for ease of construction, are cast of aggregate and bonding agent materials. Such casting materials include extremely light-weight materials such as perlite, vermiculite, pumice, expanded shale and any volcanic aggregate. The casting technique utilized precludes the necessity for metal spinning or metal fabrication which is so expensive. The heat transfer tube utilized includes generally self-contained transparent or translucent cylindrical enclosures which have lens functions for concentrating, in dots, lines, or a combination of both, recovered solar energy, this to improve the temperature gradient on opposite sides of the heat exchanger tube wall so as to provide for a rapid and maximum recovery in utilization of heat, relative to the fluid carried by the heat exchanger tube.

54497 Apparatus for recovering solar energy. van Kuijk, J.P.M. US Patent 4,106,481. 15 Aug 1978. Priority date 20 Oct 1975, Netherlands, 8p.

An apparatus is disclosed for recovering solar energy comprising a plurality of fluid warming up tubes 2a-2g which extend in parallel and side-by-side relationship in one plane. Each tube has two associated plane reflection surfaces which enclose a fixed angle α' in the order of 30° to 40°. The reflection surfaces are arranged to be pivoted and moved transversely to said plane so that their bisector plane containing the centerline of the respective tube can be maintained directed to the sun without reflection surfaces associated with successive tubes overshadowing each other.

54498 Solar concentrator-collector. Anderson, D.E. (to Suntec Systems, Inc.). US Patent 4,088,120. 9 May 1978. Filed date 2 Sep 1976. 18p.

A solar heat concentrator-collector is disclosed comprising, in combination, solar radiation concentrator means and collector means for receiving the concentrated solar energy and providing for conversion of the energy into usable or more readily convertable form. The concentrator means may be of a variety of concentrators known and used in the art, however the collector means of the present invention functions extremely well with a line focus Fresnel array, the array including a plurality of generally parallelly disposed elongated self-supporting elements or panels each with a reflective surface, and with each element or panel having means for positioning its reflective surface in an operative solar viewing disposition. The collector means when adapted for use with a line focus Fresnel array includes an energy absorbing means such as one or more conduits, each having a fluid heat transfer medium moving therethrough, and with an improved shroud enclosing at least a portion of the collector, the shroud comprising a radiation permeable member having an outer surface concave to the concentrator and defining a transmissive path for a substantial portion of the incident radiation. The configuration of the surface of the radiation permeable member provides a re-entrant path for any radiation which is reflected from the surface thereof. The conduit carrying the heat transfer medium has a closed cross-section such as an elongated member of circular or rectangular cross-section to form a cylinder, or other regular structure, and with the axis of the fluid transfer conduit or conduits being generally parallel to the longitudinal axis of the array of reflective surfaces or panels.

54499 Options for solar thermal conversion. Kreith, F.; Lameiro, G.F.; Brown, K.C. (Solar Energy Research Inst., Golden, CO). *SPIE Semin. Proc.;* **114**: 22-34(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

The impetus and form are outlined for one of the research tasks to be undertaken at the Solar Energy Research Institute. Two options, the high temperature option and the intermediate temperature option, are usually specified for solar energy development. Evidence is presented which supports the need for immediate research into the intermediate temperature, supplementary source role for solar thermal power in the United States. Particularly promising is a technological approach which will match industrial process heating demands to currently available solar concentrating collector systems. The impact appears to be strong, with 19% of US energy input falling at temperature demand levels less than 177°C (350°F). A detailed industrial process heat data base is to be assembled and matched to the system performance of major concentrator types. Solar concentrator characteristics are generally outlined and areas for immediate improvement suggested. An example of the matching of a concentrator system to a specific task is included.

54500 Vacuum solar thermal collector with optimal concentration. Garrison, J.D. (San Diego State Univ., CA). *SPIE Semin. Proc.;* **114**: 35-42(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

Space heat, hot water, air conditioning and process heat utilize more than 40% of US energy consumption. These uses provide the greatest opportunity for solar energy to contribute significantly to the US and world energy needs. In order to compete economically with other energy sources for these uses and also achieve the higher operating temperatures required for air conditioning and process heat (up to ~ 200°C), a solar collector must have low energy loss and low cost. Low loss requires vacuum to eliminate conduction and convection losses, and concentration onto a selective absorber to minimize radiation loss. Optimum concentration, or minimum ratio of absorbing surface area to collecting area, requires Winston concentration. The apparent motion of the sun indicates the use of cylindrical concentration with axis east-west. A series of arguments leading to optimum performance at near minimum cost indicate the collector should be of all glass tubular construction. A mirror coating on side and bottom inside surfaces provides concentration onto an internal glass tube coated with selective absorber. The window is only slightly convex to withstand atmospheric pressure while keeping reflection losses low. Heat transfer calculations, which are used to minimize losses, help fix the collector length and width. Radiation collection calculations determine the acceptance angle and other parameters.

54501 Optical evaluation techniques for reflecting solar concentrators. Butler, B.L.; Pettit, R.B. (Sandia Labs., Albuquerque, NM). *SPIE Semin. Proc.;* **114**: 43-49(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

Reflecting solar concentrators must possess good specular reflectance and optical quality. Quantitative techniques to evaluate beam spreading have been developed to allow analysis of concentrator performance. These techniques, known as bidirectional reflectometry and laser ray trace inspection, are summarized and examples of their usefulness for evaluation of solar concentrators are given. Data on contour errors found in model parabolas of various constructions and data on the specular reflectance of common mirror materials are included. A data format is outlined which allows the experimental results to be used for collector design, quality control and/or concentrator specification.

54502 Nonimaging solar concentrators. Schertz, W.W. (Argonne National Lab., IL). *SPIE Semin. Proc.;* **114**: 60-66(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

The class of nonimaging concentrators are described that achieve the maximum concentration of light permitted by physical principles. Examples of the concentrators for different absorber shapes are shown, and the modifications necessary to make a practical collector are discussed. The performance of an experimental collector is also shown.

54503 Comparison of the solar concentrating properties of truncated hexagonal, pyramidal and circular cones. Burkhard, D.G.; Shealy, D.L.; Strobel, G.L. (Univ. of Georgia, Athens). *SPIE Semin. Proc.;* **114**: 67-94(1977). (CONF-770868—).

From 21. annual technical symposium of the Society of Photo-Optical Instrumentation; San Diego, CA, USA (22 Aug 1977).

The concentrating properties of specularly reflecting pyramids, hexagons and circular cones are examined. The concentration factor is determined as a function of the coefficient of reflection and the shape and orientation of the incident sunlight. Reflector designs allowing multiple reflections for both normal and oblique incidence are considered.

54504 Shading effect for uniformly spaced solar collector arrays on plane surfaces. Chiang, C.W.; Hopkins, D.C. (South Dakota School of Mines and Technology, Rapid City). pp 121-126 of Heat transfer in solar energy systems. Howell, J.R.: Min, T. (eds.). New York, NY; American Society of Mechanical Engineers (1977).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Nov 1977).

This paper provides a methodology to calculate the optimum relative spacing of collectors in a uniform array for a wide variety of applications. For a given latitude, collector slope and azimuthal orientation the designer can easily determine from the tables the

relative spacing which will result in less than 10% shading for a given time of year. The tables and graphs can also be used to determine the integrated monthly, seasonal, or yearly effect of shading for more complex problems of optimization. The results presented are for horizontal and vertical arrays, but the method of calculation is easily adapted for arbitrary plane surfaces. For instance a roof with a given slope and orientation or a hillside might be used to support an array of collectors.

54505 Natural convection characteristics of flat plate collectors. Randall, K.R.; Mitchell, J.W.; El-Wakil, M.M. (Univ. of Wisconsin, Madison). pp 9-16 of Heat transfer in solar energy systems. Howell, J.R.: Min, T. (eds.). New York, NY; American Society of Mechanical Engineers (1977).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Nov 1977).

Local and average heat transfer coefficients for natural convection between parallel plates inclined between 45 and 90° from the horizontal have been experimentally studied using interferometric techniques. The experimental conditions were similar to those existing in flat plate solar collectors. Correlations have been developed for the local and average heat transfer Nusselt numbers as functions of tilt angle and Grashof number. The results are useful in determining the top loss coefficient for flat plate collectors and, eventually, for finding means of minimizing these losses.

HEAT STORAGE

REFER ALSO TO CITATION(S) 54440, 55026

54506 Latent heat storage techniques. Telkes, M. (American Technological Univ., Killeen, TX). pp 325-336 of Energy from the sun. Chicago, IL; Institute of Gas Technology (1978).

From Symposium on energy from the sun; Chicago, IL, USA (3 Apr 1978).

The latent heat of fusion or transition of compounds, alloys or eutectics can be calculated from the entropies of fusion of elements forming them. Observed and calculated values are compared to show the accuracy of this method. Latent heat storage materials must meet performance criteria of high heat of fusion per unit weight and volume and low expansion during melting. The obvious requirements must be maintained, using only those materials that are non-combustible, do not explode, are not toxic, caustic or corrosive. Examples of higher temperature materials are shown in graph form. Salt-hydrates are economically and technically most suitable for solar heat storage. Increasing the efficiency of gas-heated domestic furnaces is feasible by storing a major part of the heat, discharged in combustion gases through the stack or chimney.

54507 Heat transfer analysis of a system for annual collection and storage of solar energy. Beard, J.T.; Iachetta, F.A.; Duvall, M.D.; Dickey, J.W.; Lilleleht, L.U.; Dirhan, L.A.; Coyle, M.F. (Univ. of Virginia, Charlottesville). pp 113-119 of Heat transfer in solar energy systems. Howell, J.R.: Min, T. (eds.). New York, NY; American Society of Mechanical Engineers (1977).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Nov 1977).

A new annual collection and storage system for solar heating of buildings is operational at the University of Virginia. Results of early data and computer simulations have demonstrated the build-up of collected energy during the initial charge-up phase of the pool operation. Although the boundary conditions used in the simulations to date may not have been the most realistic ones, the results with the models so far indicate that heat losses from the prototype pool are low enough to permit significant storage of collected solar energy in the pool on an annual basis. Future work will include modifications to the models to incorporate variable energy input from the solar collector to the storage pool as well as the energy demand by the load. This will be necessary before model validation with performance data from the prototype pool can be attempted. 15 references.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 54282

54508 (EPA/600/7—78-121, pp 218-223) **LBL geothermal brine data compilation project.** Cosner, S.R.; Apps, J.A. (Univ. of California, Berkeley). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Data on geothermal fluids from the principal geothermal resources in the United States are being compiled at the Lawrence Berkeley Laboratory. The data collected are stored on a computer system to facilitate selective retrieval and manipulation. Printed copies of the compilation will be available with documentation from the laboratory as Report LBL—5936.

RESOURCE STATUS AND ASSESSMENT

USA

REFER ALSO TO CITATION(S) 54516

54509 (ALO—3992-1) **Regional operations research program for development of geothermal energy in the southwest United States. Final technical report, June 1977-August 1978.** Marlin, J.M.; Christ, R.; McDevitt, P.; Nowotny, K.; O'Dea, P.; Rao, C.R.; Swanberg, C. (New Mexico State Univ., Las Cruces (USA)). Jan 1979. Contract EG-77-S-04-3992. 836p. Dep. NTIS, PC A99/MF A01.

The efforts by the Core and State Teams in data acquisition, electric and non-electric economic studies, development of computer support functions and operations, and preparation of geothermal development scenarios are described. Team reports for the states of Arizona, Colorado, Nevada, New Mexico, and Utah are included in the appendices along with a summary of the state scenarios. (MHR)

54510 Development in California's geothermal regions: implications for Energy Commission regulatory policy. Giacosie, R.V.; Hill, D.; Hughes, E.; Willard, S. Sacramento, CA; California Energy Commission (1978). 34p. (NP—23902).

Projected time lines for development of different geothermal regions in California are summarized for the Geysers, Imperial Valley, Mono-Long Valley, Coso, and Northeast. The methodology used in preparing the time lines is included in an appendix. (MHR)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

REFER ALSO TO CITATION(S) 54561, 54563, 55642

54511 (LBL—9330) **Heat and mass transfer studies of the East Mesa anomaly.** Goyal, K.P.; Kassoy, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 10p. (CONF-781222—5). Dep. NTIS, PC A02/MF A01.

From 4. workshop on geothermal reservoir engineering; Stanford, CA, USA (13 Dec 1978).

Heat and mass transfer due to convection in a two-dimensional model of the East Mesa geothermal system are presented. These results are an extension of those presented by Goyal and Kassoy (1977). (MHR)

54512 (LBL—9458) **Fault intersections and hybrid transform faults in the southern Salton Trough geothermal area, Baja California, Mexico.** Vonder Haar, S.; Puente Cruz, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Comision Federal de Electricidad, Mexico City). Jul 1979. Contract W-7405-ENG-48. 6p. (CONF-790906—28). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Analysis of 55 wells drilled at the Cerro Prieto Geothermal Field and a suite of geological and geophysical studies throughout the southern Salton Trough from the Mexican-United States border to the Gulf of California clarify two concepts important to geothermal development: (1) increased natural convective fluid flow and better permeability should occur at intersecting faults both regionally and within a producing field, and (2) the Cerro Prieto and Imperial faults are best conceived of as hybrid types having features of both San Andreas style wrench faults and oceanic tranform faults.

54513 (NMEI—26) **Geological investigation of the Socorro geothermal area. Final report.** Chapin, C.E.; Sanford, A.R.; White, D.W.; Chamberlin, R.M.; Osburn, G.R. (New Mexico Bureau of Mines and Mineral Resources, Socorro (USA); New Mexico Inst. of Mining and Technology, Socorro (USA). Dept. of Geoscience). May 1979. 75p. New Mexico Inst. of Mining and Technology, Socorro, NM.

The results of a comprehensive geological and geochemical study of the Socorro geothermal area are presented. The following are discussed: geologic setting, structural controls, stratigraphic controls, an ancient geothermal system, modern magma bodies, geothermal potential of the Socorro area, and the Socorro transverse shear zone. (MHR)

54514 (NP—23970) **Evaluation of the hydrothermal resources of the Desert Hot Springs Region, California.** (California Energy Commission, Sacramento (USA)). Feb 1979. 84p. NTIS.

The Desert Hot Springs hydrothermal resource demonstrates its limited capacity to sustain additional utilization and development. The evaluation included, the delineation of the areal extent, determination of the hydraulic characteristics, calculation of a safe yield, and identification of the source of heat. The areal extent based on well water temperatures and the area enclosed by 90°F (32°C) isotherm, is about 5.5 square miles. Thirteen aquifer tests were conducted which indicated the average transmissivity to be 29,000 gallons per day per foot and the storativity to be 1.15×10^{-4}, representing an artesian system. Meteorologic and hydrologic data are used to estimate the components of the hydrologic budget for the calculation of the safe yield. The safe yield is 3,400 acre feet and the safest safe yield is 2,100 acre feet. The data generated by the field investigation is employed in a multivariate regression analysis to identify the source of heat. The analysis indicated the hydrothermal waters come to surface in the Blind Canyon fault zone before entering the Desert Hot Springs area.

54515 (VPI-SU—5648-3, pp C.124-C.135) **Structural controls of thermal springs in the Warm Springs Anticline.** Geiser, P.A. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

A preliminary summary is presented of the results of a structural investigation on the origin of thermal springs in the Warm Springs Anticline in northwestern Virginia. The investigation has suggested an hypothesis of deep meteoric circulation on a normal geothermal gradient. An alternative mechanism, of a shallow still-cooling pluton, has been rejected. The hypothesized system is based on evidence which suggests that the presence of deep zones of enhanced permeability are associated with cross-strike strike linears. These linears may reflect structural discontinuities in the continental plate along which flexing may be occurring, producing a zone above it in which extensive fracturing occurs.

54516 (VPI-SU—5648-3) **Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.** Costain, J.K.; Glover, L. III; Sinha, A.K. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Geological Sciences). 1978. Contract ET-78-C-05-5648. 311p. Dep. NTIS, PC A14/MF A01.

Separate abstracts were prepared for eighteen papers. (MHR)

54517 (VPI-SU—5648-3, pp A.4-A.30) **Petrology of the Cuffytown Creek pluton.** Becker, S.W. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

This pluton was selected for study because of its high heat production, averaging 11.3×10^{-1} cal/cm^3-sec. Previous work, geologic setting, geophysical model, petrography and microprobe analyses, fracture assemblages, whole rock chemistry, petrogenesis of the Cuffytown Creek pluton, and the location of radiogenic elements are discussed. (MHR)

54518 (VPI-SU—5648-3, pp B.26-B.32) **Granitic rocks of the Maryland Piedmont.** Sans, J.R. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

The location and approximate areal extent of the four granitic bodies considered are shown. Here the field relations of the Woodstock Granite are presented. (MHR)

54519 (VPI-SU—5648-3, pp B.46-B.58) **Blue Ridge gneisses as possible source materials for granites.** Hall, S.T. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

An attempt is made to see if it is possible to derive, chemically, some of the typical southeastern granites by partial melting of the Blue Ridge gneisses and subsequent fractional and/or equilibrium crystallization. This will be done by employing general theoretical and empirical working models of melting and crystallization trends that are followed by the major and trace elements, given an initial bulk composition, i.e., the Blue Ridge gneisses. The study area is a traverse between Buena Vista and Lovingston, Virginia. The Winnsboro granite was chosen as a representative granite. (MHR)

54520 (VPI-SU—5648-3, pp C.2-C.23) **Lithologic character of Atlantic Coastal Plain sediments in Georgia, South Carolina, and North Carolina with special reference to the 1978 drilling program.** Lambiase, J.J. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

The existing data on sediments and groundwater are summarized and the lithologic sequences encountered in the wells drilled in each state are predicted. (MHR)

54521 (VPI-SU—5648-3, pp C.111-C.123) **Thermal modeling.** Dunbar, J. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Two thermal modeling computer programs were developed. The first program computes theoretical heat flow anomalies in regions affected by arbitrarily shaped, three-dimensional radiogenic volumes. The second program computes the temperature field in half space containing three-dimensional sources and in an overlying insulating layer. The heat flow program was used to generate theoretical heat flow anomaly maps of the Liberty Hill, Pageland, and Cuffytown Creek plutons. A series of hypothetical models is used to demonstrate how radiogenic bodies with different rates of heat production and geometries affect the temperature field. (MHR)

54522 (VPI-SU—5648-4, pp A.2-A.37) **Reconnaissance geologic setting of the Petersburg granite and regional geologic framework for the Piedmont in southeastern Virginia.** Bobyarchick, A.R. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

The regional geologic framework is described into which Petersburg granite was emplaced, and modifications of that framework by post-intrusion deformations are outlined. (MHR)

54523 (VPI-SU—5648-4, pp A.38-A.60) **Description of the Palmetto pluton, Georgia.** Speer, J.A.; Becker, S.W. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Previous work, petrography, contact metamorphic effects, Palmetto granite in the Brevard zone, heat generation, and the Palmetto drill hole are described. (MHR)

54524 (VPI-SU—5648-4, pp A.61-A.70) **Fission track studies of the Liberty Hill pluton (I) and comments on U-Th-Pb disequilibrium studies of the Liberty Hill pluton.** Speer, J.A. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Two fission track maps of Liberty Hill pluton thin sections were studied. Corresponding fission track maps and thin sections are compared for the fine-grained and coarse-grained granites. Uranium distribution and lead isotopic composition are discussed. (MHR)

54525 (VPI-SU—5648-5) **Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.** Costain, J.K.; Glover, L. III; Sinha, A.K. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Geological Sciences). 1979. Contract ET-78-C-05-5648. 259p. Dep. NTIS, PC A12/MF A01.

Nine papers are included. Separate abstracts were prepared for each. (MHR)

54526 (VPI-SU—5648-5, pp A.4-A.59) **Prograde metamorphism of the pelitic rocks in the contact aureole and xenoliths of the Liberty Hill pluton, South Carolina.** Speer, J.A. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

The Liberty Hill pluton, South Carolina, one of the ca. 300 yr old, coarse-grained granites of the southeast USA Piedmont, is surrounded by a contact metamorphic aureole that ranges in width up to 4 km on the surface. The country rocks have an earlier, regional greenschist facies assemblage of chlorite + vermiculite + epidote + albite + quartz. The mineral isograds encountered toward the granite contact are: vermiculite-out, epidote-albite-out which coincides with cordierite-biotite-andesine-in, chlorite-out, K feldspar-in, and magnetite or muscovite-out. Andalusite, sillimanite, garnet and orthopyroxene appear in the xenoliths. The successive contact metamorphic facies are greenschist, amphibolite, and granulite. Electron microprobe analyses indicate that the Fe-Mg minerals vary systematically in composition with metamorphic grade. The most prominant change is the Fe enrichment of the silicate assemblage in the aureole, resulting from a succession of continuous reactions which consume the Fe-Ti oxides, muscovite, and chlorite to produce cordierite and biotite. The estimated pressure for the contact metamorphism is 4.5 kb (4.5×10^8 Pa), which corresponds to a depth of emplacement of between 15 and 18 km for the Liberty Hill pluton. The temperatures estimated for the xenoliths are 670 to 740°C. Maximum estimates of temperature in the aureole are 680°C at the contact and less than 610°C in the outer-most aureole. PH_2O is thought to be about half P/sub total/ in the xenoliths. PH_2O cannot be determined for the aureole. The Liberty Hill pluton has a core of

biotite-amphibole granite with granulite facies xenoliths and a border comprised of biotite and muscovite-biotite granite with amphibolite facies xenoliths. This geometry suggests a radial variation in intensive parameters within the granite, most likely temperature, oxygen fugacity, and water fugacity.

54527 (VPI-SU—5648-5, pp A.60-A.83) **Study of the pre-cretaceous basement below the Atlantic Coastal Plain.** Gleason, R.J. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

The distribution and nature of basement well data for New Jersey, Maryland, Delaware, Virginia, North Carolina, and Georgia are shown. Depths to pre-cretaceous basement estimated for each of the heat flow test holes drilled to data are tabulated. (MHR)

NON-USA

54528 Geological conditions for thermal manifestations of the Zhirovoi river basin (southwestern Kamchatka). Grib, E.N.; Leonov, V.L.; Florenskii, I.V.; Khramov, N.A. *Byull. Vulkanol. Stn., Akad. Nauk SSSR;* No. 52, 92-102(1976). (In Russian).

A description is given of Neogene-Quarternary chiefly volcanogenic formations of the Zhirovoi Bay region, the Vilyuchenskoi Bay, and the Zhirovoi river basin. An examination is made of the basic stages of volcanic activity in this region and its tectonic structure. The Zhirov thermal springs were shown to be located within the northwestern dip of a major anticline fold in the joint zone of one of the latest fractures of the meridional course. 10 references, 3 figures, 2 tables.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 54516

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 54521

54529 (LA—7953-MS) **Geophysical lineaments of Arizona.** Lepley, L.K. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 40p. Dep. NTIS, PC A03/MF A01.

Photolineaments seen on satellite images are usually expressions of deep crustal ruptures. However, photolineaments are omnipresent and an independent expression of regional discontinuities is needed to help rank the photolineaments. Published gravity and magnetic contour maps of Arizona were analyzed to produce a single geophysical lineament map to indicate trends of regional basement structures. This map shows that the southwestern quarter of Arizona is dominated by a NNW-ENE orthogonal system whereas the remainder of the state is gridded by a NW-NE system. North-south systems are present throughout the state, as are EW lineaments. Arizona is transected by the WNW Texas Strand, but other shorter systems trending in the Texas direction are found throughout the state south of the Strand. The major lineament systems as seen on Landsat, gravity, and magnetic maps correlate reasonably well with known geothermal manifestations. Many other systems are Precambrian, Paleozoic, and/or Mesozoic in age but appear to control the location of Quaternary volcanic systems.

54530 (VPI-SU—5648-3, pp C.24-C.35) **Geothermal gradients in the southeastern United States.** Dashevsky, S.S. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Equilibrium temperature gradients were determined in drill holes RL1, RL2, RL3, RL4, RL5, PT1, PG1, and ED1. Preliminary gradients have been determined for SM1, SM2, PM1, and StF1. Locations and temperature logs and gradients are shown; and gradients are tabulated. Several more weeks are required before the latter group of holes will reach thermal equilibrium. An equilibrium gradient was also determined from drill hole PD1, a hole drilled by private industry in the slate belt of North Carolina. Attempts to measure an equilibrium temperature profile in the Jesup well in Georgia (JE1) were unsuccessful due to congealed drilling mud left in the hole.

54531 (VPI-SU—5648-3, pp C.36-C.57) **Heat flow and heat generation.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg); Perry, L.D.; Dashevsky, S.; Conrad, B.U. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Locations of holes drilled to date by VPI and SU in the southeastern United States are shown. Geothermal gradients, thermal conductivities, and heat flow determinations available to date are summarized.

54532 (VPI-SU—5648-3, pp C.58-C.64) **Linear relationship between heat flow and heat generation.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg); Perry, L.D. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

The relationship between heat flow and heat generation for all holes available to date in the southeastern United States is shown. The heat flow and heat generation values used in the linear relationship are tabulated. (MHR)

54533 (VPI-SU—5648-3, pp C.65-C.110) **Gravity data in the southeastern United States.** Cogbill, A.H. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Gravity measurements have been obtained in three separate areas of the Atlantic Coastal Plain (ACP). These areas are (1) southeastern Georgia and northeastern Florida, (2) southeastern New Jersey, and (3) south-central Delaware. Gravity measurements were made using LaCoste-Romberg model G gravity meters. The present distribution of gravity measurements is shown in maps for Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, and New Jersey. (MHR)

54534 (VPI-SU—5648-4, pp C.2-C.9) **Atlantic Coastal Plain drilling program.** 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Seventeen holes have been drilled in New Jersey, Delaware, Maryland, and Virginia. Locations of the holes are indicated. Geothermal gradients are shown over selected depth intervals and estimated depths to basement for all of the holes logged to date. A representative sampling of the thermal conductivity of core determined with needle probe techniques is given and the range of thermal conductivities to be expected in sediments of the Atlantic Coastal Plain is shown. (MHR)

54535 (VPI-SU—5648-4, pp C.22-C.32) **Heat flow and heat generation.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg); Perry, L.D.; Dashevsky, S.; Sans, B.U. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Locations of holes drilled to date by VPI and SU are shown and heat flow values in the southeastern United States are summarized. Geothermal gradients, thermal conductivities, and heat flow determinations available to date are summarized. Heat generation data for a hole in the Siloam, GA granite is given. (MHR)

54536 (VPI-SU—5648-4, pp C.33-C.36) **Linear relationship between heat flow and heat generation.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg); Perry, L.D. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

The relationship between heat flow and heat generation for all holes available to date in the southeastern United States is shown. Heat flow and heat generation values used in the linear relationship are summarized.

54537 (VPI-SU—5648-5, pp C.2-C.19) **Geothermal exploration methods and results: Atlantic Coastal Plain.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg). 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

The geophysical techniques used to investigate the geologic framework of potential geothermal resources of parts of the eastern United States are discussed briefly. Radiogenic heat-producing granite buried beneath a thick blanket of sediments of low thermal conductivity is the principal subject here. The origin of the hot springs of Virginia is discussed. (MHR)

54538 (VPI-SU—5648-5, pp C.20-C.27) **Geothermal resource potential of the northern Atlantic Coastal Plain.** Lambiase, J.J.; Dashevsky, S.S.; Costain, J.K.; Gleason, R.J.; McClung, W.S. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

Geothermal gradients determined in 66 exploratory holes in the Atlantic Coastal Plain suggest that, in many areas, temperatures will be in excess of 60° at the basement surface. The transmissibility of the deep aquifers beneath the Coastal Plain must be determined before the feasibility of a geothermal resource can be evaluated.

54539 (VPI-SU—5648-5, pp C.28-C.51) **Heat flow in the Atlantic Coastal Plain.** Perry, L.D. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

Heat flow values are now complete for sixteen holes in the Atlantic Coastal Plain. The locations of the values are shown and the values are listed along with locations, intervals, gradients, and conductivity values. Individual thermal conductivity values from each hole are tabulated. (MHR)

54540 (VPI-SU—5648-5, pp C.139-C.153) **Heat flow and heat generation.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg); Perry, L.D.; Dashevsky, S.; McClung, W.S.; Higgins, S.P. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

Locations of holes drilled to date by VPI and SU are shown and heat flow values in the southeastern United States are summarized. Geothermal gradients, thermal conductivities, and heat flow determinations available to date are tabulated. Temperature logs are shown and heat generation values are given. (MHR)

54541 (VPI-SU—5648-5, pp C.154-C.157) **Linear relationship between heat flow and heat generation.** Costain, J.K. (Virginia Polytechnic Inst., Blacksburg); Perry, L.D. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

The relationship between heat flow and heat generation for all holes available to date in the southeastern United States is given. Heat flow and heat generation values used in the linear relationship are summarized. (MHR)

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 54513, 54523, 54524, 54579

54542 (EPA/600/7—78-121) **Second workshop on sampling geothermal effluents.** Gilmore, D.B. (Geonomics, Inc., Berkeley, CA (USA)). Jun 1978. 254p. (CONF-770227—). Dep. NTIS, PC A12/MF A01.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Fourteen papers were represented by abstracts only and are listed by title. Separate abstracts were prepared for seventeen. (MHR)

54543 (EPA/600/7—78-121, pp 55-68) **Sampling and analysis of hot and cold spring waters and associated rock and soil samples from potential geothermal resources areas in north central Nevada.** Bowman, H.R.; Wollenberg, H.; Asaro, F.; Hebert, A. (Lawrence Berkeley Lab., CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

The principal objective of the geochemical section of the geothermal resource assessment program at L.B.L. is to develop and evaluate new techniques and methods for sampling and analyzing materials associated with hot spring activities. The analytical methods were mainly (1) neutron-activation-analysis (NAA), (2) non-dispersive x-ray-fluorescence-analysis (XRF), and (3) gamma-ray-spectrometry (GRS). These methods together are capable of testing for over 50 elemental abundances in rock, soil, and evaporated water samples. The methods complement one another wih NAA primarily used for trace and minor elements, XRF for the more abundant elements, and GRS for the radioactive elements. The rather high precisions of these methods allow considerable cross-checking of elemental abundances determined by the different methods. The analytical results indicate that: (1) H_2S (determined by XRF) and W (determined by NAA) both correlate with down hole temperatures within a specific geothermal system; (2) the uranium daughters, determined by GRS measurements of spring waters and deposits, are most abundant in $CaCO_3$ dominated systems; (3) uranium may be concentrating at depths within hydrothermal systems.

54544 (EPA/600/7—78-121, pp 84-96) **Review of the chemical composition of geothermal effluents.** Tsai, F.; Juprasert, S.; Sanyal, S.K. (Geonomics, Inc., Berkeley, CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

A literature survey on the chemical composition of geothermal effluents is presented. As wide a geographical area as possible was covered in the hope of getting a general idea of the concentration ranges of various constituents. The geothermal areas considered in this report are from New Zealand, Japan, Italy, Iceland, USSR, Central America, Mexico, and the United States. The data were obtained mainly from published sources.

54545 (EPA/600/7—78-121, pp 97-112) **Development of geothermal gas sampling equipment.** Tonani, F.B. (GeoChemex, Berkeley, CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Experience in developing equipment for geothermal gas sampling under a wide range of conditions is summarized. Considered conditions have been: weight; ruggedness for operation in tough access sites by one or two man parties; capability to sample tiny seepages of gas from loose ground, scoriae, fissures, hand-drilled holes in fumarole areas; and independence from assumptions regarding what happens to a gas sample on storage (for example, no "air corrected" analyses). These requirements have led to the development of small sampling tubes pressurized with gas carrier (the same to be used on GC analysis), then pressurized with the sample gas. Successful use of the Draeger detector tubes to analyze geothermal and volcanic gases in the field has been made possible by accurate study of their behavior. Questions, such as which components work under certain conditions, how to proceed under conditions entirely different from the ones envisioned by the manufacturer, etc., have been answered after years of only partially successful field missions. Water, carbon dioxide, hydrogen sulfide and $H_2S + SO_2$ tubes have proved to be dependable. For more precision at high concentration of carbon dioxide, pocket sized absorbing devices have been built. Commercially available materials have often needed to be complemented by specially-designed ones.

54546 (EPA/600/7—78-121, pp 130-140) **Collection of chemical, isotope, and gas samples from geothermal wells.** Nehring, N.L.; Truesdell, A.H. (Geological Survey, Menlo Park, CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Reconstruction of the downhole composition in a geothermal well requires field measurements of total fluid enthalpy and separator pressure along with chemical, isotope, and gas analyses of separated water, steam condensate, and gas phases. Analyses of each phase for components distributed between phases are necessary because the fluids may not be in equilibrium at the sampling points. Cooling after separation must be sufficient to prevent loss of volatiles and water vapor. The collection and analysis schemes presented are designed to allow complete chemical and gas analyses and isotopic analyses of major carbon, oxygen, hydrogen, and sulfur containing species.

54547 (EPA/600/7—78-121, pp 145-159) **Estimation of pollutant characteristics from geochemical surface investigations.** Tonani, F.B. (Geochemex, Berkeley, CA); Meidav, H.T. Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Estimation of reservoir chemistry is ipso facto an estimation of pollution potential due to leakage of effluents during exploration or production from that reservoir. The estimation of reservoir chemistry is one of the important goals of field chemistry. Reservoir chemistry may be estimated under a variety of conditions and in many different ways: when the water issuing in a hot spring is proven to be a direct leakage of reservoir water (and hence chemical thermometry may be applied in its simplest form); when the spring or well water is a mixture of reservoir water and, for example, shallow groundwater, mixing models are utilized to determine geochemical temperatures, and concurrently resulting in estimation of true reservoir chemistry; when a mixing model cannot be determined, based upon the chemical analysis itself, external constraints can be used to determine the mixing models. Such constraints may be other types of data, such as electrical resistivity. When a reasonable estimate of reservoir temperature may be made, a correlation of temperature vs salinity may result in a similar constraint; in absence of specific information about the reservoir water, statistics of chemical composition of underground or surface water in the same general area usually provides a reasonable prediction of reservoir chemistry; when a fumarole occurs in the area, the gas chemistry can be employed to infer the composition of the liquid phase, through the computation of chemical equilibrium. This applies strictly to volatile substances, but previous knowledge of correlation between the volatile substances and other dissolved constituents may result in estimates of the composition of reservoir water.

54548 (EPA/600/7—78-121, pp 160-165) **Sampling and analysis of geothermal brines from Niland Field, California.** Bishop, H.K. (San Diego Gas and Electric Co., CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

The Salton Sea Geothermal Field, which lies just south of the Salton Sea in the Imperial Valley of Southern California, produces a highly saline brine. Development of this resource requires that the properties of the geothermal fluids be fully understood. Currently, San Diego Gas and Electric (SDG and E) in cooperation with the US Energy Research and Development Administration has constructed and is operating a 10-MW Geothermal Loop Test Facility (GLEF), which utilizes geothermal fluid from the Salton Sea Field.

SDG and E's experience in sampling and analyzing the geothermal fluid flowing through the GLEF is discussed.

54549 (EPA/600/7—78-121, pp 166-173) **Interpretation of analytical results, thermal and nonthermal waters, lava plateaus region of northeastern California and southern Oregon.** Klein, C.W.; Koenig, J.B. (GeothermEx, Inc., Berkeley, CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Nonthermal spring and well waters of the Lava Plateaus region (60,000 km^2) are characterized by low TDS (average < 150 μmho/cm) and the weight abundance relationships Ca > Na ≧ Mg > K and HCO_3 + CO_3 >>> SO_4 = Cl. SiO_2 varies widely, averaging about 25 to 30 mg/l but reaching 50 to 70 mg/l in waters derived from lacustrine sediment or glassy tuff. Evolution of CO_2 gas becomes more notable with increased proximity to the volcanically active High Cascades. Lakes occupying closed basins in this region show greatly increased TDS. Within the anion group, HCO_3 + CO_3 >> SO_4 = Cl is still common, but certain waters contain SO_4 and sometimes Cl in greater abu dance than the carbonate-bicarbonate ions. Major cation concentrations are highly variable; either Na or Ca predominates; and K is usually the least abundant.

54550 (EPA/600/7—78-121, pp 175) **Chemical profile of the East Mesa Geothermal Field, Imperial County, California.** Littleton, R.T.; Burnett, E. (Bureau of Reclamation, Boulder City, Nevada). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

The East Mesa Geothermal Field, about 18 miles east of El Centro, California, is a thermal knot in saturated deltaic and lacustrine sediments. A deep convective system drives geothermal fluids through a reservoir of interconnected lenses of sand and sandstone throughout a depth interval of about 4500 feet between about 7500 and 3000 feet. A gross evaluation of the geochemical profile of the reservoir is attempted by interpretation of the resistivity and self-potential curves of the dual induction log. The geochemical profile shows a typical pattern throughout the reservoir. Typically, salinity increases with depth reaching a maximum between 2000 and 3000 feet, then decreasing to about 6000 feet, and then increasing sharply to a depth of about 7500 feet. Below 7500 feet it is impossible to compute salinities with confidence and the reasons are discussed. The shape and dimensions of the geothermal field in relation to depth are discussed. Chemical profiles are computed from dual induction logs of 10 geothermal wells in and around the East Mesa Geothermal Field and related to laboratory analysis of fluids recovered from drill stem tests and produced at the wellhead. The relation of the geochemical profiles to the movement of geothermal fluids in the reservoir is discussed.

54551 (EPA/600/7—78-121, pp 190-210) **Status report, Raft River Project sampling, analysis, and environmental effects studies.** Allen, A.C.; Baldwin, J.M.; McAtee, R.E. (Allied Chemical Corp., Idaho Falls, ID). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Sampling methods presently being used for the geothermal wells and associated effluents at the Raft River Geothermal site near Malta, Idaho, are described. Analytical techniques used for species difficult to accurately determine are discussed. Also reported are the plans for the on-site laboratory under construction; including the analytical support it will provide.

54552 (UCRL—15072) **Trace metal speciation in saline waters affected by geothermal brines. Final technical report.** Sposito, G. (California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences). Jul 1979. Contract W-7405-ENG-48. 71p. Dep. NTIS, PC A04/MF A01.

The computer program GEOCHEM was developed and applied to calculate the speciation of trace elements, such as Li, B, Mn, Co, Ni, Cu, Zn, Pb, and As, in mixtures of geothermal brines with soil waters. A typical speciation calculation involved the simultaneous consideration of about 350 inorganic and organic complexes and about 80 possible solid phases that could form among the macro- and microconstituents in the mixtures. The four geothermal brines chosen for study were from the East Mesa, Heber, and Salton Sea KGRA's. Two examples of East Mesa brine were employed in order to illustrate the effect of brine variability within a given KGRA. The soil waters chosen for study were the Holtville, Rosita, and Vint soil solutions and the Vail 4 drain water. These waters were mixed with the four brines to produce 1%, 5%, and 10% brine combinations. The combinations then were analyzed with the help of GEOCHEM and were interpreted in the context of two proposed general contamination scenarios. The results of the speciation calculations pointed to the great importance, in brine, of sulfide as a precipitating agent for trace metals and of borate as a trace metal-complexing ligand. In general, precipitation and/or exchange adsorption in soil were found to reduce the levels of trace metals well below harmful concentrations. The principal exceptions were Li and B, which did not precipitate and which were at or very hear harmful levels in the soil water-brine mixtures.

54553 (VPI-SU—5648-4, pp A.71-A.77) **Fission track study of the WIN-1 drill hole.** Becker, S.W. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Four samples from the WIN-1 drill hole were prepared for fission track analysis. They indicated that the distribution of uranium changes little with depth in the range 25 to 580 meters. Concentrations of uranium and thorium and values of heat production for these samples are listed. (MHR)

54554 (VPI-SU—5648-4, pp A.78-A.85) **Petrology of drill core ED-1 from the Cuffytown Creek pluton.** Becker, S.W. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Core has been taken from a hole 299.5 m deep, drilled near the center of the Cuffytown Creek pluton. Sixteen samples have been analyzed for major element chemistry, and measurements of heat production and U and Th content were made on fourteen samples. (MHR)

54555 (VPI-SU—5648-4, pp B.2-B.9) **Behavior of uranium and thorium during differentiation of the Woodstock granite.** Sans, J.R. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

The major element and radioelement chemistry of forty-nine rock samples collected from the Woodstock Granite and the surrounding Woodstock Gneiss Dome is discussed. The uranium, thorium, and potassium content of forty-two of these samples was determined by gamma-ray spectroscopy. The same suite of samples has now been analyzed for major element chemistry by x-ray fluorescence. (MHR)

54556 **Relationship between the chemical composition of thermal waters and seismic activity.** Markhinin, E.K.; Bozhkova, L.I. *Byull. Vulkanol. Stn., Akad. Nauk SSSR;* No. 52, 37-41(1976). (In Russian).

An examination is made of the relationship between the chemical composition of a number of thermal springs on Kunashir Island and earthquakes. The amount of certain chemical components, particularly Cl, SO_4, CO_2, and NH_4, was found to increase in thermal springs with an increase in their seismicity. 1 figure, 6 tables.

54557 **Earthquakes and sulfur group gases of the Shiveluch volcano (1965 to 1972).** Kardanova, O.F.; Kirsanova, T.P.; Firstov, P.P. *Byull. Vulkanol. Stn., Akad. Nauk SSSR;* No. 52, 49-55(1976). (In Russian).

An analysis is made of the connection between the chemical composition of gases and the general and seismic activity of volcanos. The nature of changes in SO_2 and HCl in connection with earthquakes is demonstrated by illustrations taken from observations of the Shiveluch volcano (1965 to 1972). The sulfur group gases exhibit the strongest connection in this regard. The amount of those gases usually increases two to three months after earthquakes. It is hypothesized from the materials collected that a time study of both phenomena would make it possible to determine the depth of the gas phase division, the velocity with which it reaches the surface, and other parameters. This would also offer additional criteria for short-term prognoses of volcanic eruptions. 18 references, 3 figures.

54558 **Zn, Pb, Cu, and Cd in volcanic and thermal spring vapor.** Nikitina, L.P.; Menyailov, I.A. *Byull. Vulkanol. Stn., Akad. Nauk SSSR;* No. 52, 62-70(1976). (In Russian).

Gases and vapors, but not thermal springs, are carriers of heavy metals both in active volcanos and in the thermal spring systems of Kamchatka and the Northern Kuriles. The following arrangement (in descending order) was noted with respect to the content of heavy metals in condensates and steam jets: erupting volcanos - volcanos in the solfatara stage - thermal spring systems. 8 references, 2 figures, 2 tables.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 54553

54559 (EPA/600/7—78-121, pp 211-216) **Borehole geophysical logging as complement to geothermal well effluent sampling.** Sanyal, S.K.; Weiss, R.B. (Geonomics Inc., Berkeley, CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

Sampling and analysis of well effluents are an important means of detecting ground water pollution. There are, however, some drawbacks in this technique. If water is sampled from an uncased (open hole) well, the water represents a mixture of water

from various permeable layers, rather than from an individual layer. This is an undesirable situation if water quality varies significantly from layer to layer. If the water is sampled from a cased well, the sample represents only the layers at the depths of well completion. One way of obtaining a continuous vertical profile of water quality with depth is to apply geophysical borehole logging to complement well effluent sampling and analysis, in both open and cased holes. Both real and hypothetical examples are given to illusrate the potential role of borehole geophysical logging in pollution monitoring.

54560 (LA—7922-MS) **Benefit/cost analysis for research in geothermal log interpretation. Final report.** Rigby, F.A.; Reardon, P. (Science Applications, Inc., La Jolla, CA (USA)). Jul 1979. Contract W-7405-ENG-36. 110p. Dep. NTIS, PC A06/MF A01.

Well log interpretation, the process of inferring subsurface geology from geophysical measurements made in boreholes, is the most versatile and direct means available of assessing important physical and structural reservoir properties. Historically, well logging has been developed primarily for use in oil and gas wells, and its application in a different environment such as a geothermal reservoir creates complex problems. Present geothermal development is severely hindered by lack of data. Adaptation of well logging techniques holds the promise of reducing development costs, encouraging investment, and assisting regulatory permitting. Such benefits will translate directly into lower power costs and an increased domestic energy supply. A significant acceleration of geothermal power-on-line is possible plus cost reductions through reduction of drilling failure rate, reduction of average well cost, earlier recognition of bad wells, reduced flow testing, and savings due to provision of better data for regulatory decisions. Net undiscounted benefits in 1979 dollars from improving logging and interpretation in geothermal areas can exceed half a billion dollars in slightly more than a decade, about 300 million of this should be regarded as the potential benefit of the Los Alamos Scientific Laboratory Geothermal Log Interpretation Program or similar research.

54561 (VPI-SU—5648-4) **Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.** Costain, J.K.; Glover, L. III; Sinha, A.K. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Geological Sciences). 1978. Contract ET-78-C-05-5648. 158p. Dep. NTIS, PC A08/MF A01.

The first results for the Atlantic Coastal Plain drilling program are reported by the Geophysics group for 17 holes drilled in New Jersey, Delaware, Maryland, and Virginia. Average geothermal gradients range from about 25°C/Km to a high of 45°C/Km. Three sites, Salisbury, MD, Crisfield, MD, and Wallops Island, VA, have sufficiently high thermal gradients to warrant further study to outline the thermal anomaly and to discover if they are associated with a potential field anomaly. Separate abstracts were prepared for 13 papers.

54562 (VPI-SU—5648-4, pp C.10-C.21) **Geothermal gradients, well logging.** Dashevsky, S.S. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

The well logging operation has closely monitored the drilling program in the Atlantic Coastal Plain. The 300-meter heat-flow holes were logged repeatedly during the first several days and relogged throughout the following weeks. Temperature gradients over specific intervals are plotted with respect to time elapsed since cementing for two holes in New Jersey. An exponential cooling equation associated with the rate of decay of heat of solidification of cement in one of these is plotted. (MHR)

54563 (VPI-SU—5648-5, pp C.52-C.138) **Lithologic analysis of sediment samples from the intermediate drilling program.** Svetlichny, M. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

Lithologic descriptions of the drill cuttings are tabulated. Each category reflects the proportion of gravel, sand, and silt plus clay in that sample. Sand and gravel are distingushed by size. Whole and fragmented macrofossils were reported as shells. Selected samples from each hole are being wet sieved with a number 230 US standard sieve to determine the proportion of sediment that is finer than 4.0 phi. (MHR)

54564 **Prospecting system using rotating superconducting electromagnetic dipole.** Morrison, H.F. (to Regents of the University of California). US Patent 4,165,480. 21 Aug 1979. Filed date 12 Dec 1977. 6p.

A prospecting system uses a rotating superconducting electromagnetic source which is swept over a frequency range with a magnetometer type receiver sensing the induced field. The effective dipole is rotated in a horizontal plane parallel to the ground surface with the sensed induced magnetic field being in the vertical axis.

54565 **Method and apparatus for acoustic well logging of earth boreholes.** Buckner, G.O. (to Dresser Industries, Inc.). US Patent 4,140,994. 20 Feb 1979. Filed date 2 Nov 1977. 10p.

In order to prevent late arriving and higher amplitude shear waves from saturating the subsurface amplifier, the amplitude of each succeeding positive half cycle of the earlier arriving compressional wave is measured and a negative feedback is supplied to the amplifier if the measured amplitude exceeds 50% of full scale. Circuitry is provided for utilization of a two transmitter, two receiver system using the same type of negative feedback to control the gain of the subsurface amplifier.

LEGAL AND INSTITUTIONAL ASPECTS

54566 (GE—3114-T1) **Statistical characterization of the Federal Geothermal Leasing and Permitting Program. Final report, 18 April 1978-31 January 1979.** Beeland, G.V.; Ludington, J.A.; Schumann, E. (Wapora, Inc., Chevy Chase, MD (USA)). Jan 1979. Contract ET-78-C-01-3114. 90p. Dep. NTIS, PC A05/MF A01.

The ineffectiveness thus far in the Federal geothermal leasing program is documented. Leases have been issued on only 18 percent of non-competitive applications on land under BLM jurisdiction and two percent of applied-for National Forest land. It has taken an average of about two years to get a lease, although the time lapses involved are extremely erratic, and many applications have been pending since January 1974, the first month applications were accepted. Some gradual improvement in BLM performance was demonstrated, however. Only about 250 competitive leases have been issued on the 50 percent of BLM KGRA acreage and the two percent of KGRA acreage in National Forests which has been offered. The US Geological Survey postlease permitting performance is also non-uniform in timeframes required for approvals. To some extent, this has resulted from stated lessee priority.

ECONOMIC AND FINANCIAL ASPECTS

54567 (CONF-790803—44) **Today's geothermal power economics and risks.** Lawford, T.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Capital and power generation costs are developed as a parameterized composite of a number of ongoing geothermal power projects, and evaluates several of the most commonly accepted risks of geothermal power in terms of cost penalties to a basic cost of power. The status of geothermal power in the US is also reviewed briefly.

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 54551, 55629

54568 (CONF-781109—30) **Siting criteria as a function of sensitivity of nesting ferruginous hawks to geothermal development.** White, C.M.; Thurow, T.L.; Sullivan, J.F. (Brigham Young Univ., Provo, UT (USA). Dept. of Zoology; Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1570. 11p. Dep. NTIS, PC A02/MF A01.

From Environmental control symposium; Washington, DC, USA (28 Nov 1978).

The ferruginous hawk has been studied over a number of years in the Raft River Valley area of south-central Idaho and consequently its population densities and dynamics are known. The ferruginous hawk is to be used as a barometer to the effects of human disturbance as might be found during geothermal development. It was proposed to determine what sort of buffer zones need to be established around the species to be compatible with the concepts of multiple use, and accumulate information and baseline data useful to such studies. (MHR)

54569 (CONF-790906—26) **Effects of controlled disturbance on ferruginous hawks as may occur during geothermal energy development.** White, C.M.; Thurow, T.; Sullivan, J.F. (Brigham Young Univ., Provo, UT (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Portions of document are illegible.

The impacts on the ferruginous hawk of treatments designed to simulate those encountered during geothermal developments were assessed at the Raft River Geothermal Test Site. The objective of the study was to ascertain the tolerance limits of the disturbance-sensitive hawks to human- and development-related activities. Various impact treatments were imposed on 10 nests during the 1978 nesting season and 13 nests during 1979. Three nests were deserted in 1978 and four in 1979; treatment nests that successfully hatched eggs produced statistically fewer young than control nests. Data suggest that buffer zones of ≅ 1.6 km around each nest be established to minimize deleterious impacts on this hawk species. Utilization of biological systems indicative of ecosystem stress is discussed.

54570 (EPA/600/7—78-121, pp 3-13) **Dynamic measurement of ambient airborne gases near geothermal areas.** Jepsen, A.F. (Eureka Resource Associates, Inc., Berkeley, CA); Langan, L. Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

The dynamic measurement technique is described and some data obtained in this way from geothermal areas are presented. Applications include not only environmental assessment but also geological reconnaissance.

54571 (EPA/600/7—78-121, pp 16-41) **Review of the determination of hydrogen sulfide in air by the cadmium hydroxide-STRactan colorimetric method: current practices and modifications.** McCurdy, R.A.; Altshuler, S.L. (Pacific Gas and Electric Co., San Ramon, CA). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

An in-depth analysis has been performed on several calibration procedures for the cadmium hydroxide-STRactan method for one-hour sampling of ambient hydrogen sulfide (H_2S) concentrations. This is the method recommended by the California Air Resources Board. Results show the calibration procedures to be susceptible to varying sulfide losses during the development of the color depending on the glassware and volumes of reagents used. Agreement can be achieved between the use of aqueous sulfide solutions standardized by an iodometric titration and the use of gravimetrically calibrated H_2S permeation tubes when similar glassware and reagent volumes are used. In addition, the use of the cadmium hydroxide-STRactan method for 24-hour sampling was evaluated; a 46 percent loss was observed.

54572 (EPA/600/7—78-121, pp 70) **How can standard methods for sampling and analysis support the motives behind the regulations.** Michels, D.E. (Idaho National Engineering Lab., Idaho Falls). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

The need for regulations to properly reflect the relationship between the geothermal effluents and their environmental effects is explored. Good regulations require input from pathway and bio-effect studies. These inputs are discussed. (MHR)

54573 (ORO—5401-T2) **Environmental analysis of geopressured-geothermal prospect areas, Brazoria and Kenedy Counties, Texas.** White, W.A.; McGraw, M.; Gustavson, T.C. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1978. Contract EG-77-S-05-5401. 213p. Dep. NTIS, PC A10/MF A01.

Preliminary environmental data, including current land use, substrate lithology, soils, natural hazards, water resources, biological assemblages, meteorological data, and regulatory considerations have been collected and analyzed for approximately 150 km^2 of land: (1) near Chocolate Bayou, Brazoria County, Texas, where a geopressured-geothermal test well was drilled in 1978, and (2) near the rural community of Armstrong, Kenedy County, Texas, where future geopressured-geothermal test well development may occur. The study was designed to establish an environmental data base and to determine, within spatial constraints set by subsurface reservoir conditions, environmentally suitable sites for geopressured-geothermal wells.

54574 (UCRL—15054) **Geysers-Calistoga KGRA geothermal environmental overview: water quality.** Moore, S.F.; Pimentel, K.D.; Krone, R.B. (Resource Management Associates, Lafayette, CA (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Davis (USA)). Feb 1978. Contract W-7405-ENG-48. 79p. Dep. NTIS, PC A05/MF A01.

Important water-related issues of concern are identified and the available information regarding potential impacts on the quantity and quality of water in an area is assessed. The results of a study and a two-day workshop that included representatives of developers and of concerned local, state, and federal agencies are presented. An inventory of existing data is included in an appendix. (MHR)

BY-PRODUCTS

REFER ALSO TO CITATION(S) 54576

GEOTHERMAL POWER PLANTS

54575 (TREE—1081(Rev.)) **THERPP: a thermodynamic properties program.** Deeds, R.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 100p. Dep. NTIS, PC A05/MF A01.

The computer program THERPP, a program that calculates the thermodynamic properties of light hydrocarbons and mixtures of light hydrocarbons, is documented. A specific pressure-temperature or pressure-enthalpy grid is input to obtain properties in the desired region. THERPP is a modification of the program HSGC. Thermodynamic properties are calculated using Starling's modification to the Benedict-Webb-Rubin equation of state.

54576 **Energy transfer apparatus and method using geothermal brine.** Awerbuch, L. (to Bechtel International Corp.). US Patent 4,152,898. 8 May 1979. Filed date 1 Aug 1977. 8p.

A multi-effect system for using the heat, water and solids content on geothermal brine to produce useful work, fresh product water and inorganic salts. A flash separator receives brine from a geothermal well and provides the initial steam forming the heat source for the brine flowing through a first effect of the system. The system has a number of effects in series with each effect having means for generating steam from the brine flowing through it, and using the generated steam to provide the heat source for the next adjacent effect. Steam from each effect is also moved in heat exchange relationship to a binary fluid in a closed loop containing a gas turbine so that the binary fluid can be heated sufficiently to drive the turbine, the latter, in turn, being coupled to a work-producing apparatus, such as a generator. In one form of the invention, the steam to heat the binary fluid is the uncondensed part of the steam used as a heat source for each effect. In another form of the invention, this steam is part of the steam generated in each effect. Condensate formed in each effect from the steam received thereby is transferred to the next adjacent effect and, from the last effect, the condensate is drawn off as fresh product water. Brine blowdown removed from one or more of the effects provides the source of inorganic salts. As disclosed herein, the effects are vertical tube evaporators.

DESIGN AND OPERATION

54577 (EPRI-ER—1099) **Heber geothermal demonstration power plant. Final report.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Jun 1979. 171p. Dep. NTIS, PC A08/MF A01.

The binary power plant is to be a 45 MW net electrical facility deriving energy from the low salinity (14,000 ppM), moderate temperature (360°F, 182°C) Heber reservoir in Southern California. The optimized baseline design established for the power plant is described, and the design and optimization work that formed the basis for the baseline design is documented. The work accomplished during Phase II, Preliminary Design is also recorded, and a base provided from which detailed plant design could be continued. Related project activities in the areas of licensing, environmental, cost, and schedule are also described. The approach used to establish the Phase II optimized baseline design was to (1) review the EPRI Phase I conceptual design and feasibility studies; (2) identify current design criteria and state-of-the-art technology; and (3) develop a preliminary design optimized to the Heber site based on utility standards.

GEOTHERMAL ENGINEERING

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

54578 (EPA/600/7—78-121, pp 46-54) **Sampling and characterization of suspended solids in brine from Magmamax number 1 well.** Hill, J.H.; Otto, C.H. Jr. (Univ. of California, Livermore). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

When high temperature, high salinity geothermal brines are cooled, appreciable quantities of solids precipitate. These suspended solids can cause extensive erosion and plugging in power plant components. In addition, there is considerable concern that reinjection of these solids with spent brine may plug the geologic formation adjacent to the reinjection wells. Work done to sample these solids and characterize them so that processes can be devised for their removal or control is described. Suspended solids produced in brine from Magmamax number 1 well consist primarily of an iron-rich amorphous silica gel. A sampling apparatus to filter these solids out of high temperature, high pressure brine streams is described. Their

chemical composition and physical description are discussed. Rates of production of suspended solids are given for brines flashed through nozzles and flashed in steam separators. Control of solids production by acidification to a pH < 4.5 is described. At this time, control by acidification seems to offer an attractive alternative to conventional methods (filtering, settling, etc.) for removing suspended solids from spent brine prior to reinjection.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 54514

54579 (EPA/600/7—78-121, pp 114-129) **Techniques of pressure and temperature measurement and sampling in geothermal wells.** Ross, L.W.; Brown, L.L.; Williams, R.E. (Univ. of Denver, CO). Jun 1978.

From 2. workshop on sampling and analysis of geothermal effluents; Las Vegas, NV, USA (15 Feb 1977).

The Denver Research Institute, in the course of a program for establishing a manual for the design of wells for exploitation of hydrothermal sources of geothermal energy, developed a need for highly accurate temperature and pressure measurements, and for determining the chemical composition of the fluid deep within the well, before flashing took place. Therefore DRI reviewed the scientific principles available for performing such measurements, and designed a probe for T and P measurements in real time. This probe was tested for the first time in well 8-1 in the East Mesa field in September 1976. The sampler selected for high temperatures is based on a design that was developed at the Los Alamos Laboratories, but commercially available samplers can be used at temperatures up to about 400°F. Laboratory and field results, and a comparative review of measurement tools available to the geothermal industry, are reported. Experiences of other investigators, and current industry trends, are also summarized.

54580 (LBL—9248) **Evaluation of potential geothermal well-head flow sampling and calorimeter methods.** Cliff, W.C.; Apley, W.J.; Creer, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract W-7405-ENG-48. 27p. (GREMP—7). Dep. NTIS, PC A03/MF A01.

The results of the evaluation of potential geothermal well-head calorimeter systems and flow sampling techniques are presented. The candidate calorimeter systems and flow sampling configurations are presented and discussed. The systems and configurations are compared and ranked relative to their potential usefulness for obtaining enthalpy measurements and representative sample flows at geothermal well heads. A preliminary test plan is presented to briefly indicate the type of field tests that are recommended for further development of selected candidate calorimeter methods and sample flow withdrawal apparatus.

54581 (LBL—9303) **Downhole pressure changes measured with a fluid filled capillary tube.** Miller, C.W.; Zerzan, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 18p. (CONF-790920—1). Dep. NTIS, PC A02/MF A01.

From Annual meeting of the Society of Petroleum Engineers; Las Vegas, NV, USA (23 Sep 1979).

An analysis was done on the transmission of a pressure signal through a small diameter ($\simeq$ 0.14 cm) fluid transmission line. The effects of the viscosity and compressibility of the fluid, of the tubing size, and of the temperature changes with time were investigated. Both an oil and a nitrogen filled tube were considered. For a small disturbance, say 1% of the bulk modulus, the propagation of the pressure signal was characterized by a diffusion equation with a source term. For large disturbances, compressibility effects become significant and the signal propagation must be described by a wave equation with damping. A comparison was done between the theoretical model and experimental results with excellent agreement. An oil filled tubing could be described by the small disturbance equation. The pressure response of a nitrogen filled tubing was modelled with the large disturbance equation. It is also shown that for the former case, the wellhead data can be inverted to give the actual downhole pressure using a minimization technique.

54582 (LBL—9606) **Simulation of the depletion of two-phase geothermal reservoirs.** Pruess, K.; Bodvarsson, G.; Schroeder, R.C.; Witherspoon, P.A.; Marconcini, R.; Neri, G.; Ruffilli, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Ente Nazionale per l'Energia Elettrica, Florence (Italy)). Aug 1979. Contract W-7405-ENG-48. 19p. (CONF-790913—8). Dep. NTIS, PC A02/MF A01.

From 54. annual technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

The simulator SHAFT79 has been used to study the depletion of different types of geothermal reservoirs. Investigations of idealized systems include effects of gravity and fluid injection. Pressure decline is analyzed as a function of cumulative production. The main conclusions are as follows: (1) the well-known p/Z-method for estimating fluid reserves is not applicable to two-phase geothermal reservoirs; (2) there is a strong tendency towards spatially uniform boiling. This causes a pressure decline which allows in many cases estimates of the total reservoir volume and of the total heat content of the reservoir rock; (3) propagation of a boiling front through a deep water table, as a consequence of fluid production, gives rise to a peculiar pattern of pressure decline. This may allow prediction of the distance of the water table from the producing wells and of the vertical thickness of the water zone, thereby giving important clues to estimating fluid reserves; (4) the pressure effects of injection of colder fluid depend strongly on (one- or two-) phase conditions in the reservoir, upon injection rate, and upon absolute permeability. Average pressure may actually decline in two-phase reservoirs rather than increase due to injection. Preliminary results of a case-history investigation of the Serrazzano zone at Larderello, Italy, are presented. SHAFT79 has been used for a fully three-dimensional simulation of a geologically accurate model of the Serrazzano reservoir. Comparison of computed results with field data allows improved estimates of reservoir conditions and parameters.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

54583 (NMEI—27) **Enhanced heat extraction from hot-dry-rock geothermal reservoirs due to interacting secondary thermal cracks. Final report.** Hsu, Y.C. (New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). Apr 1979. 41p. Univ. of New Mexico, Albuquerque, NM.

How the fluid circulating through the main hydraulic fracture and the thermally-induced secondary, growing, interacting cracks affects the time-varying temperature, deformations, stresses, thermal crack geometry, water flow rates through the main and thermal cracks, reservoir coolant outlet temperature, and reservoir thermal power of the cracked geothermal reservoir is investigated. First, a simplified version of the proposed hot-dry-rock reservoir is considered. A closed-form solution of the rock temperature without thermal crack was found and substituted into SAP-IV computer code to calculate the stresses. These stresses being superposed with earth stresses and fluid pressure were used in conjunction with the fracture mechanics criterion to determine the initiation of secondary thermal crack. After the initiation of secondary thermal crack, the rock temperature was then calculated by a two-dimensional heat conduction program AYER. The detailed procedures for carrying out these steps are listed. Solutions developed are applied to studying the time-varying temperature field, thermal stresses and crack geometry produced, and additional heat power generated in the reservoir. Conclusions were discussed and summarized. (MHR)

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 54438

54584 (CONF-790906—24) **Potential for utilizing geothermal resources for the culture of freshwater fish.** Sullivan, J.F.; Beleau, M.H. (Idaho National Engineering Lab., Idaho Falls (USA); Idaho Univ., Moscow (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

Portions of document are illegible.

An evaluation of geothermal aquaculture demonstrated significant commercial potential. Growth rates of cultured channel catfish and common carp were high throughout the study. Various physiological and morphological parameters were monitored; no differences were detected between fish reared in geothermal or fresh water.

54585 (CONF-790906—27) **District heating with geothermally heated culinary water supply systems.** Pitts, D.R.; Schmitt, R.C. (Clemson Univ., SC (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-06-1570. 4p. Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council annual meeting; Reno, NV, USA (24 Sep 1979).

An initial feasibility study of using existing culinary water supply systems to provide hot water for space heating and air conditioning to a typical residential community is reported. The Phase I study has centered on methods of using low-to-moderate temperature water for heating purposes including institutional barriers, identification and description of a suitable residential commnity water system, evaluation of thermal losses in both the main distribution system and the street mains within the residential district, estimation of size and cost of the pumping station main heat exchanger, sizing of individual residential heat exchangers, determination of pumping and power requirements due to increased flow

through the residential area mains, and pumping and power requirements from the street mains through a typical residence. All results of the engineering study of Phase I are encouraging.

54586 (DOE/CS/31744—1) **Feasibility study of residential and commercial heating using existing water supply systems. Phase I. Final technical report, November 1, 1978-May 31, 1979.** Pitts, D.R. (Clemson Univ., SC (USA). Dept. of Mechanical Engineering). 1979. Contract EM-78-S-07-1744. 46p. Dep. NTIS, PC A03/MF A01.

A preliminary study of the feasibility of using existing drinking water supply systems to provide hot water for heating purposes to a typical 140-home subdivision has been undertaken. This preliminary study has centered on (i) types of municipal water system designs and effects of system design upon heating use; (ii) methods of using low-to-moderate temperature water for heating purposes and possible institutional barriers; (iii) identification and description of a typical residential community suitable for hot water heating; (iv) evaluation of thermal losses in the uninsulated main distribution system from the main pumping station having assumed geothermal heating to the subdivision; (v) evaluation of thermal losses in the uninsulated street mains in the subdivision; (vi) estimation of size and cost of the pumping station main heat exchanger to supply geothermal energy to the drinking water; (vii) sizing of individual house heat exchangers; (viii) pumping and power requirements to supply the increased water flow rate through the subdivision street water distribution lines; and (ix) pumping and piping requirements to provide heating water flow from the street lines to a typical residence. From the results obtained thus far, it would appear that the use of existing uninsulated water supply systems will be advantageous in many communities having nearby low-to-moderate temperature geothermal resources.

54587 (IDO—1570-T17) **Heat pumps: primer for use with low temperature geothermal resources.** Keller, J.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 16 Nov 1977. Contract EY-76-C-07-1570. 24p. Dep. NTIS, PC A02/MF A01.

Attention is focussed on using heat pumps to obtain heat energy from low temperature geothermal resources. The principles of heat pumps are examined to explore applications in residential and commercial heat requirements. Availability and costs are discussed. This is intended to serve as a primer and user document requiring no background in heat pump technology. (MHR)

54588 (NP—23877) **Economic study of low temperature geothermal energy in Lassen and Modoc Counties, California.** (California Energy Commission, Sacramento (USA)). Apr 1977. 92p. California Energy Commission, 1111 Howe Ave., Sacramento, CA.

The feasibility of using low cost, low temperature geothermal energy in job-producing industries to increase employment and encourage economic development was investigated. The study, encompassing all of Lassen and Modoc Counties, was to be site-specific, referencing candidate geothermal applications to known hot wells and springs as previously determined, or to new wells with specific characteristics as defined in the Scope of Work. The emphasis was to be placed on economically practical and readily achievable applications from known resources. Although both positive and negative findings were found in specific areas of investigation, it is felt that the overall long term prognosis for geothermal energy stimulus to industry in the area is excellent. The applications studied were; greenhouse heating, kiln drying, onion dehydration, feedlots, and aquaculture.

GEOTHERMAL DATA AND THEORY

54589 (VPI-SU—5648-3, pp B.66-B.85) **Chemical file system.** Galligan, F.; Crum, G. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

An interactive and time geological chemical data system required for immediate analysis of chemical components, isotopic ratios, etc., is described. (MHR)

PROPERTIES OF AQUEOUS SOLUTIONS

REFER ALSO TO CITATION(S) 54552, 54578

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 54523, 54554, 54555

54590 (UCRL—52757) **Experimental study of the dynamic viscosity of some anhydrous silicate melts to 1953 K at 150 kPa.** Weed, H.C.; Piwinskii, A.J.; Dibley, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1979. Contract W-7405-ENG-48. 211p. Dep. NTIS, PC A10/MF A01.

The dynamic viscosity was measured for six anhydrous silicate melts, obtained by fusing various rocks collected from the Department of Energy's Nevada Test Site, from 1393 to 1953 K at 150 kPa. These silicate melts exhibit Newtonian behavior in this temperature interval. Experimental results indicate that tuff viscosity > alluvium viscosity > basalt viscosity. At 1673 K, viscosities of Schooner tuff (Ue20μ-330'), alluvium (U10ba), and Danny Boy basalt (Ue18q No. 2) are 28,460 Pa.s, 4,820 Pa.s, and 12.6 Pa.s, respectively. Activation energies for viscous flow in the interval between 1393 and 1953 K range from 268 to 393 kJ/mole.

54591 (VPI-SU—5648-3, pp A.31-A.39) **Progress in fission track analyses.** Becker, S.W.; Speer, J.A. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Progress in determining the distribution of U in granitic rocks by fission track analysis is reviewed. Preliminary work on the distribution of U and Th has been performed using the electron microprobe to test the applicability of this approach. (MHR)

54592 (VPI-SU—5648-3, pp A.41-A.76) **Petrographic and petrologic description of a sub-coastal plain basement core from near Jesup, Georgia.** Gleason, R.J. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

A compilation from literature of all existing data for wells which penetrate the basement is underway. The second research aspect consists of direct observation of drill-core samples obtained from wells which have penetrated and recovered basement material from beneath the Coastal Plain. A description summary is given on the research concerning the first such core. (MHR)

54593 (VPI-SU—5648-3, pp B.2-B.7) **Siloam granite.** Merz, B.A. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Fourteen samples from the Siloam, Georgia pluton have been analyzed for major element chemistry. The Siloam normative Qz-Ab-Or data are shown plotted on the water saturated phase diagram. The effect of an An component on the Qz-Ab-Or 2Kb saturated system is shown. (MHR)

54594 (VPI-SU—5648-3, pp B.8-B.20) **Leaching experiments.** Merz, B.A. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

The results of early radioelement leaching experiments in which crushed rock samples were leached with strong mineral acids are difficult to interpret for two reasons. Firstly, the locations within the rock from which the radioelements were leached are not well known and, secondly, since the action of a strong acid over a short period probably is not equivalent to the action of groundwater during weathering, the results cannot be related to processes occurring in nature. In this series of experiments, portions of a sample from the Rion, South Carolina, pluton were leached with dilute acid and alkali solutions as well as with natural groundwater. No appreciable loss of either U or Th was observed and this is believed to be due to prior loss of the readily removable radioelement fraction. The hypothesis that the most easily removed fraction of the radioelement content is that held on grain boundaries is being tested.

54595 (VPI-SU—5648-3, pp B.33-B.45) **Distribution of uranium, thorium and potassium in the weakly-foliated granitic rocks of the Maryland Peidmont.** Sans, J.R. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Fifty-eight rock samples from the Maryland Piedmont were analyzed for uranium, thorium, and potassium by means of gamma-ray spectroscopy. Geochemical interpretation of the information is presented. The four weakly-foliated granitic plutons of the Maryland Piedmont are: the Woodstock Granite, the Guilford Granite, the Ellicott City Granodiorite, and the Gunpowder Granite. The Woodstock was analyzed in detail (thirty-nine samples). The Guilford (six samples), Ellicott City (three samples) and Gunpowder (ten samples) were analyzed on a reconnaissance basis.

54596 (VPI-SU—5648-4, pp B.10-B.11) **Siloam cores.** Hall, S.T. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

One core hole each was drilled into the medium-grained Siloam granite and the porphyritic Siloam granite from the Siloam, Georgia pluton. Eighteen samples from each were analyzed for

major element chemistry. The ranges in alkali and CaO contents of both sets of core samples are shown. The Siloam core normative Qz-Ab-Or data are plotted on the water-saturated phase diagram. The effect of the An component and also the fields where the surface samples plot are shown.

54597 (VPI-SU—5648-4, pp B.12-B.13) **Palmetto granite.** Hall, S.T. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Six samples from the surface of the Palmetto, Georgia granite and fourteen core samples were analyzed for major element chemistry. The Qz-Ab-Or water saturated phase diagram is shown with the normative Palmetto surface and core sample data projected onto it. (MHR)

54598 (VPI-SU—5648-4, pp B.14-B.21) **Pageland granite.** Hall, S.R. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, July 1, 1978-September 30, 1978.

Twelve surface samples and ten core samples were analyzed for major element chemistry. One of the surface samples is from the granodiorite at the center of the Pageland pluton and the rest are from the Pageland monzogranite itself. The ranges in alkali and CaO contents of both the core and surface monzogranite samples and the range of U and Th values of the surface samples are shown. The Qz-Ab-Or water-saturated phase diagram is shown with the normative Pageland surface and core sample data projected onto it with the effect of An content indicated. (MHR)

54599 (VPI-SU—5648-5, pp B.2-B.6) **Correlation of radioelement content to surficial weathering processes.** Sinha, A.K. (Virginia Polytechnic Inst., Blacksburg); Hall, S.T.; Sans, J.R. 1979.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, October 1, 1978-March 30, 1979.

Preliminary geochemical analysis of WIN-1 core by using various techniques suggests some measurable degree of weathering to depths of nearly 500'. The leaching experiments need to be more rigorously pursued and the two generations of calcite need to be analyzed for delta 018 and Sr87/Sr86 ratios. It will permit an understanding of the nature of the fluid for discrimination between fresh versus marine water interactions. Methods that can be used to understand recent losses of uranium are reported.

ISOTOPE AND TRACE ELEMENT STUDIES

REFER ALSO TO CITATION(S) 54524

54600 (VPI-SU—5648-3, pp B.21-B.25) **U-Th-Pb disequilibrium studies.** Sinha, A.K. (Virginia Polytechnic Inst., Blacksburg); Merz, B.A. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Preliminary data are presented on some selected samples from three plutons. The U and Th concentrations were determined by gamma ray spectrometry, while lead concentrations were determined by gamma-ray fluorescence. Some results are shown graphically. (MHR)

54601 **Distribution of trace elements in several contemporary thermal spring minerals.** Ogorodov, A.S. *Byull. Vulkanol. Stn., Akad. Nauk SSSR;* No. 52, 71-82(1976). (In Russian).

The content of trace elements in contemporary thermal spring-altered rocks and minerals in emptying areas of thermal spring systems is determined by the original composition of the rock, isomorphism during the regeneration of minerals and their adsorptive properties. Newly formed minerals, except kaolinite and montmorillonite, which are good adsorbents, are poor in microelements, i.e. minerals which are formed at lower temperatures are freer of admixtures. 2 references, 2 tables.

TIDAL POWER

WAVE ENERGY CONVERTERS

54602 **Water wave energy conversion device using flexible membranes.** French, M.J. US Patent 4,164,383. 14 Aug 1979. Priority date 26 May 1976, United Kingdom of Great Britain and Northern Ireland (UK), 4p.

A device for conversion of sea wave energy comprises partially inflated bag-like enclosures formed from flexible impermeable material. The enclosures are connected via non return valves to a high pressure conduit and a low pressure return conduit so as to act as an air pump or bellows as the sea rises and falls around the enclosures. A turbine extracts energy from the high pressure conduit, the exhaust returning to the low pressure return conduit.

54603 **Device for converting the energy of sea water.** Nedyalkov, I.P.; Kanchev, K.T.; Trenkov, S.R. (to CUV Progress). US Patent 4,162,409. 24 Jul 1979. Priority date 8 Jun 1976, Bulgaria, 6p.

A device for converting the energy of sea waves into electrical energy is described. A tank-like inlet converter receives sea water from the peaks of waves and discharges it to a water-driven turbine. The turbine drives an electrical generator. Spent water from the turbine is delivered to an outlet converter which delivers the spent sea water to the troughs of the waves. The inlet and outlet converters are provided with controllable water inlet and outlet valves, respectively, which control the flow of sea water into and out of the inlet and outlet converters, respectively.

WIND ENERGY

REFER ALSO TO CITATION(S) 54285

ECONOMICS

54604 (SAND—78-0962) **Economic analysis of Darrieus vertical axis wind turbine systems for the generation of utility grid electrical power. Volume IV: summary and analysis of the A. T. Kearney and Alcoa Laboratories point design economic studies.** Sullivan, W.N.; Nellums, R.O. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 249p. Dep. NTIS, PC A11/MF A01.

The A. T. Kearney and Alcoa economic studies are two independent attempts to assess the installed costs of a series of six Darrieus vertical axis wind turbine designs. The designs cover a range of sizes with peak outputs from 10 to 1600 kW. All are designed to produce utility grid electrical power. Volume IV of this report summarizes, compares, and analyzes the results of these studies. The Kearney and Alcoa final reports are included in the Appendices.

54605 (SAND—78-0962(Vol.3)) **Economic analysis of Darrieus vertical-axis wind turbine systems for the generation of utility grid electrical power. Volume III. Point designs.** Grover, R.D.; Kadlec, E.G. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 94p. Dep. NTIS, PC A05/MF A01.

Volume III of this study discusses major features of the Darrieus vertical-axis wind turbine design including the blades, the speed increaser, guy cables and cable anchors, transmission, clutch, brakes, and the electrical system. System weight characteristics are tabulated. The report discusses operation and maintenance costs and requirements and concludes with detailed descriptions of point designs for 120, 200, 500, and 1600-kW Darrieus vertical-axis wind-energy systems. These same point designs are used for the detailed economic analyses discussed in Volume IV.

54606 (COO—2992-78/1(Exec.Summ.)) **Application study of wind power technology to the city of Hart, Michigan, 1977. Executive summary.** Asmussen, J.; Krauss, O.; Park, G.L.; Linvill, D.E. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Aug 1978. Contract EY-76-S-02-2992. 14p. Dep. NTIS, PC A02/MF A01.

Several generation-exansion alternatives for small electric utilities which include windpower were evaluated using the municipal electric system of Hart, Michigan, as an example. Assumed wind turbine configurations with machines rated at 500-kW and 1,500-kW together with a 1,000-kW hydroelectric facility were combined with conventional Hart diesel generation plus bulk purchase and then evaluated. For comparison, a new 3,600-kW oil-fueled diesel generator was also evaluated. Wind data from US Coast Guard stations in the Hart vicinity was processed and verified by means of a 2-year measurement program. It was discovered that wind velocities along the eastern shore of Lake Michigan are significantly higher than indicated for the area by nationally-published wind density information. Average velocities range from 5 to 7 meters per second (m/s).

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 55021

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 54605

ELECTRIC POWER ENGINEERING

POWER PLANTS AND POWER GENERATION

54607 (CAEC—008) **Assessment of quality assurance in nonnuclear power plants.** (Nuclear Services Corp., Campbell, CA (USA)). Jul 1978. 91p. Nuclear Services Corporation, 1700 Dell Avenue, Campbell, CA.

This study assesses the level of quality assurance being applied by the California utilities to their nonnuclear power plant systems. The scope and specific purpose of the study are: (1) review the current status within the major utilities of management controls that are being implemented to assure that each nonnuclear thermal power plant is sited, designed, constructed, and operated to comply with the considerations for public health and safety and the provision of reliable supplies of energy; (2) determine if the management controls are adequate for (1) above, and make recommendations accordingly; (3) consider the cost-effectiveness of the recommendations relative to the utilities and the State Energy Resources Conservation and Development Commission; and (4) recommend future activities or studies that should be undertaken by the Commission consistent with and necessary to implement the recommendations. A series of visitations and interviews were held with various individuals within each major California utility to determine the means and mechanisms for implementing management controls. The utilities involved in the study were Los Angeles Department of Water and Power; Pacific Gas and Electric Company; Sacramento Municipal Utility District; San Diego Gas and Electric; and Southern California Edison.

54608 (FE—1726-30A) **Engineer, design, construct, test and evaluate a pressurized fluidized bed pilot plant using high sulfur coal for production of electric power. Phase I: preliminary engineering. PFB combustor/heat exchanger rig test at Leatherhead.** (National Coal Board, Leatherhead (UK). Coal Utilization Research Lab.; Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Dec 1977. Contract EX-C-01-1726. 67p. (CW-WR—76-016.30A). Dep. NTIS, PC A04/MF A01.

A test of 100 hour duration has been carried out in the pressurized combustor at Leatherhead, England, to investigate the behavior of a heat exchanger and distributor plate designed and fabricated by Curtiss-Wright and Dorr-Oliver. The heat exchanger consisted of seven large diameter, vertical, finned tubes in a fluidized bed of 8 ft. depth. Datum operating conditions were: pressure, 6 atm absolute; fluidizing velocity, 2 1/2 ft/s; and bed temperature, 1600/1650°F. Bed temperature was also varied over the range 1450°F to 1730°F. Temperature distribution in the bed was extremely uniform (+- 30°F or better) with no evidence of significant clinkering or poor fluidization. Combustion efficiency at datum conditions was 98 1/2 to 99%, with little, if any, combustion in the freeboard. The outside (bed to tube) heat transfer coefficient for the central tube cooled by air, calculated using NRDC test data, was approximately 45 Btu/hr ft^2 °F. The overall heat transfer coefficiency between the gas and air averaged 21.8 Btu/hr ft^2 °F. Dolomite was fed at a typical Ca/S mol ration of 1.6. Equilibrium was only reached towards the end of the test, when a sulphur retention of 85% was approached. The coal was Illinois No. 6. NO/sub x/ emissions were typically 150 ppM. Start-up was demonstrated at a bed depth of 6 ft. with this heat exchanger, whereas beds with horizontally oriented tubes have required shallow bed depths for starting fluidization.

54609 (FE—1726-41A) **Engineer, design, construct, test and evaluate a pressurized fluidized bed pilot plant using high sulfur coal for production of electric power. Phase I: preliminary engineering. Quarterly report, September 1-November 30, 1977.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Dec 1977. Contract EX-76-C-01-1726. 41p. (CW-WR—76-015.41A). Dep. NTIS, PC A03/MF A01.

The test report prepared by NRDC for the PFB heat exchanger tested at the NRDC Leatherhead Facility was received by Curtiss-Wright and results are reported herein. Metallurgical evaluation of the heat exchanger has been completed. The tube materials specimens inserted in one of the Dorr-Oliver client FB reactors accumulated an additional 2600 hours of operating time before being removed. Total time was 4300 hours which exceeded the original goal. The SGT/PFB Technology Rig shakedown testing continued. A revised heat exchanger tube restraint was tested with satisfactory structural results. Coal dolomite and ash system shakedown testing during rig operation has resulted in numerous revisions to system details and operating procedures to alleviate interruptions in feeding and discharging of materials. Design and fabrication were initiated for modifications being incorporated into the SGT rig to test a broad range of candidate PFB tube materials, turbine materials, coatings for the foregoing candidates and several on-line particulate monitoring instruments. Final pilot plant design proceeded from the preliminary design completed last quarter. The specification for the secondary hot gas clean-up system was completed and work is nearly complete on the coal preparation and injection equipment and the dolomite injection equipment specifications. Control system definition and specification of control equipment, valves and instrumentation is continuing.

54610 (INIS-mf—4538) **Safety evaluation of liquid radioactive effluents treatment system in a BWR reactor, through the LIQM03 code.** Zorrilla R, S.H. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Fisica y Matematicas). 1978. 249p. (In Spanish). Dep. NTIS (US Sales Only), PC A08/MF A01.

In this work we made a safety evaluation of the liquid radioactive effluents system in a plant using a BWR similar to that now installed in Laguna Verde. For that purpose, the computation program ORIGENwas modified, in order to keep up to date and adapt it to the PDP 10 computer, which is operating at the Computation Department of the Nuclear Center of Mexico, the code LIQM03 was the result of this modification. As usual in this work we dealt with problems which were solved opportunely, now we have at our disposal the code LIQM03 which will be in the future a very useful tool for this kind of evaluations.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 54618

54611 **Studies of the application of electromagnetic filters in power plants.** Heitmann, H.G. (Kraftwerk Union AG, Erlangen, Germany). pp 115-120 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The corrosion products occurring in service water of power plants are mainly of a ferromagnetic nature. Therefore, the substances can be removed from the water by magnetic filters. In conventional power plants, the electromagnetic filters developed for this purpose are used for boiler feedwater purity control. In nuclear power plants with pressurized water reactors, they are employed for the clean-up of steam generator feedwater, steam generator blowdown water and primar water. In nuclear power plants with boiling water reactors, they are mainly used for reactor feedwater clean-up. The research and studies involved in this application are discussed.

54612 **Pilot-scale study of condensate-feedwater polishing by high gradient magnetic filtration (HGMF).** Batra, S.K.; Hirsch, E.G. (New England Power Service Co., Westborough, MA). pp 121-126 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The results of a pilot-scale study of the removal of corrosion products in a supercritical steam generator feed water cycle by high gradient magnetic filtration (HGMF) are presented. The effects of residual time, field intensity and flow velocity during cold and hot cleanup were quantitatively examined. The HGMF was effective in reducing total iron by as much as 58% during mini-cold clean-up and 89% during the hot clean-up mode. The magnetic filtration efficiency for total iron was observed to be dependent upon iron concentration in the raw condensate. A combination of HGMF and mixed-bed condensate demineralizers offers promise of a faster clean-up, and a reduced startup time for universal pressure steam generators.

POWER CYCLES

REFER ALSO TO CITATION(S) 54394, 55137

54613 (FE—2357-30) **CFCC Development Program. Commercial plant reliability and maintainability evaluation (Task 1.4).** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Oct 1978. Contract EX-76-C-01-2357. 158p. Dep. NTIS, PC A08/MF A01.

The Coal Fired Combined Cycle (CFCC) is the unique powerplant concept developed under the leadership of the General Electric Company to provide a direct coal-burning gas turbine and steam turbine combined cycle powerplant. The advantages of the combined cycle for higher efficiency and the potential of the pressurized fluidized bed (PFB) combustor for improvements in emissions could offer a new and attractive option to the electric utility industry, after its successful development. The CFCC approach provides cooling of the fluid bed combustor through the use of steam tubes in the bed, which supply a steam turbine-generator. The partially cooled combustion gases exiting from the combustor drive a gas turbine-generator after passing through a hot-gas cleanup train. On the basis of previous studies and confirming work under this

contract, General Electric continues to believe that the CFCC approach offers important advantages over alternate approaches: higher powerplant efficiency in the combustor temperature range of interest; reduced combustor/steam generator corrosion potential, due to low fluid-bed tube temperature (as contrasted to the air in tube cycle); reduced hot-gas cleanup flow rate (as contrasted with the uncooled combustor cycle); and increased gas turbine bucket life from improved material protection systems. The present report involves mainly a failure mode analysis for components of the plant.

54614 Cycles for electric energy conversion from low-temperature energy sources. Shah, R.P. (General Electric Co., Schenectady, NY). pp 107-112 of Heat transfer in energy conservation. Goldstein, R.J.; Didion, D.; Gopal, R.; Kreider, K.; Schoenhals, R. (eds.). New York, NY; American Society of Mechanical Engineers (1977).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Nov 1977).

The thermodynamics and process economics of generating electrical power from a low temperature energy source are presented. The choice of a working fluid for the power generation cycle is very crucial, together with a proper choice of the cycle state points, if these power cycles are to be attractive. This is demonstrated by comparing the performance capabilities of steam and an organic fluid in low temperature power cycles and defining the source temperature ranges most suitable for each of these fluids. Further, a procedure is presented that would lead to an optimum choice of cycle parameters for steam and an organic fluid power cycle. In addition, the economic considerations that influence the plant selection are presented and discussed.

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 55063

COMPONENTS

54615 (FE—2455-77-5) **Conceptual design of an atmospheric fluidized-bed combustion electric power generating plant. Quarterly technical progress report, January-March 1978.** Cosgrove, E.J. (Burns and Roe, Inc., Woodbury, NY (USA)). Apr 1978. Contract EF-77-C-01-2455. 27p. Dep. NTIS, PC A03/MF A01.

The scope of this program is to perform all services to prepare a conceptual design in sufficient detail to describe and estimate cost and economics for an atmospheric fluidized-bed combustion (AFBC) electric power generating plant, and to optimize the production of electric power and any by-products from coal. As a minimum, the work shall produce a conceptual design, drawings, outline specifications, capital and operating cost estimates and documentation of all related analyses, calculations and studies for the commercial size plant. Of particular importance is the recommendation and conceptual design for scale down of the commercial plant to a size that will demonstrate the feasibility of the selected process. Based on the original program scope, the project is 99.8% complete and the expanded program is 70% complete. (LTN)

54616 Application of a low-order boiler model to transient stability studies. Bloethe, W.G. (Sargent and Lundy Engineers, Chicago, IL); Anderson, P.M. pp 5p, Paper A 76 149-5 of Text of A papers from the winter meeting of the IEEE Power Engineering Society. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE winter meeting; New York, NY, USA (25 Jan 1976).

A low-order boiler model is applied to a transient stability program. The boiler is shown to have a noticeable effect on the transient behavior of a turbine generator unit. The effect of the boiler is not great, but it does tend to make the system less stable. A tentative conclusion is that the inclusion of the boiler storage phenomenon may be important in stability studies which extend beyond five or six seconds.

54617 (FE—2357-43) **PFB coal fired combined cycle development program: management plan update.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). [nd]. Contract EX-76-C-01-2357. 33p. Dep. NTIS, PC A03/MF A01.

The follow-on program concentrates continuing activity in two major technology tasks of the current CFCC program, hot gas cleanup and gas turbine life, with supporting effort in several other areas. The prime thrust of the follow-on program is in Gas Turbine Technology and Hot Gas Cleanup. Work to date has identified the needs to protect the gas turbine from corrosion caused by substantial amounts of alkali in the submicron aerosol and vapor phase and to protect the turbine from erosion caused by multimicron-sized particulates. We believe that a solution to the corrosion protection challenge can more confidently and quickly be found by extending turbine materials work in dirty liquid fuels to the PFB environmental levels. Particulate removal for erosion protection has as its objective a better quantification of the erosion tolerance level coupled with work to improve the performance of inertial separators, including electrostatic augmentation, in the less-than-15 μm-particle-size region. Interaction between the ongoing technology and test programs at the Coal Utilization Research Laboratory will be by the described tests to be performed. Additionally, use will be made of the results of the Fireside II Corrosion Program results from the planned 1000-hour test at the Exxon mini-plant PFB. The follow-on effort, then, is keyed to the results of these PFB tests and conclusions reached from in-depth parallel laboratory investigations and analysis.

ECONOMICS

REFER ALSO TO CITATION(S) 55105

54618 (EPRI-RP—927-1) **Economics of conserving water by use of alternative cooling methods for large nuclear, fossil, and combined cycle power plants.** Rossie, J.P.; Mitchell, R.D.; Horsak, R.D.; Leidner, A.; Porter, R.M. (Beck (R.W.) and Associates, Denver, CO (USA)). Aug 1978. 92p. EPRI, Palo Alto, CA.

The development of future electric generating facilities in California is complicated by the fact that water resources generally are scarce, highly allocated, or influenced by regional institutional and legal considerations. Therefore, in order to determine the cooling system makeup water requirements for power plants and the changes in busbar energy production costs associated with the use of cooling methods which would reduce annual water requirements, computer analyses were performed for 1000-MWe nuclear, 1000-MWe fossil-fueled, and 400-MWe combined cycle power plants equipped with optimized wet, dry/wet peaking, and dry cooling tower systems for a range of site, design, and economic conditions.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 55022, 55027

FUELS

REFER ALSO TO CITATION(S) 54062

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 55052, 55096, 55118, 55119, 55120, 55121, 55122, 55124, 55125, 55629

THERMAL EFFLUENTS

54619 (ORNL/TM—6867) **Meteorological Effects of Thermal Energy Releases (METER) Program. Annual progress report, October 1977-September 1978.** Patrinos, A.A.N.; Hoffman, H.W. (comps.). (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 131p. Dep. NTIS, PC A07/MF A01.

Progress is reported in studies of the meteorological effects of thermal effluents from power plants. Information from six separate studies is presented. These studies involved: rainfall measurements near Plant Bowen in northwest Georgia; drift from mechanical draft cooling towers; environmental impact of evaporative plumes; temperature measurements of downwind plumes for plants having 3 or 4 mechanical draft cooling towers in flat terrain; the prediction of local effects of cooling ponds; and self-precipitation of snow from cooling towers. (LCL)

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

54620 (BNL—51004) **Status of pollutant removal technology for coal fired power plants in the Northeastern US.** Ziegler, E.N.; Meyers, R.E. (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract EY-76-C-02-0016. 45p. Dep. NTIS, PC A03/MF A01.

The status of air pollution control technology for coal-fired industrial and power plant boilers has been surveyed. Lime and limestone based scrubbers are capable of removing as much as 93% of flue gas sulfur dioxide at facilities supplying 800 MW power. A sludge containing sulfur oxides must be discarded in the process, usually requiring a settling pond. The Wellman-Lord, thiosorbic, and citrate processes are capable of producing salable products instead of the sludge. They are successful (85 to 90% removal) on demonstration-scale units. The Wellman-Lord process is currently being tested on large-scale coal-fired units. Electrostatic precipitators, the major control device for removing particulates, can eliminate 99.5% of the fine particles. Fabric filtration can remove 99.9% and is more efficient in the 0.2 to 2-μm size range than ESPs. Utilization of fabric filters is expected to increase significantly from its present 5% of the particulate removal market. Nitrogen oxide concentrations in coal-fired systems are usually reduced by modification of the combustion system. No significant NO/sub x/ reduction on full-scale boilers has yet been reported, but demonstrations are planned over the next few

years. Various process capital and annualized costs are reported for SO_2 and particulate removal systems. The status of fluidized bed combustion, fuel desulfurization, conversion of coal to gaseous and liquid fuels, and flue gas denitrification is also discussed.

54621 Shifting SO_2 from the stack. Hopkinson, J.; Preston, G. *EPRI J.;* 4: No. 6, 15-18(Jul 1979).

The removal of sulfur dioxide (SO_2) by lime/limestone stack scrubbers produces large amounts of sludge which must be disposed of at an economic and environmental cost. Second-generation scrubbers are aimed at improving reliability (dual-alkali process) or at eliminating the formation of sludge (Wellman-Lord and magnesia processes) and producing salable products. Three advanced systems of the third generation - the Chiyoda Thoroughbred-121 process, the absorption-steam-stripping Resox process, and the aqueous carbonate system - are all designed to eliminate the sludge problem. All three systems are at the demonstration stage and should be ready for commercial sale by 1983-1984.

54622 Steps to sludge disposal. Lihach, N. *EPRI J.;* 4: No. 6, 19(Jul 1979).

The Electric Power Research Institute has published the FGD Sludge Disposal Manual to help utilities make decisions on how to dispose of the sludge from flue gas desulfurization (FGD). Focusing on the throw-away systems, the manual takes engineering personnel through an eight-step sludge disposal program to explain the alternatives of oxidizing, thickening, fixation, etc. Treatment options are interdependent with processing, transportation, and disposal choices. Information for ordering the manual is given.

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 54607

POWER TRANSMISSION AND DISTRIBUTION

54623 (EPRI-EL—1047-SR) **Transmission static VAR systems seminar.** Marks, J.; Addis, G.; Vancers, I. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA); Minnesota Power and Light Co., Duluth (USA)). Apr 1979. 210p. (CONF-7810185—). Dep. NTIS, PC A10/MF A01.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

Nine papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

54624 (SERI-TP—35-217(Pt.2)) **Workshop on power conditioning for alternative energy technologies. Executive summary.** Smith, D.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789; EG-77-C-01-4042. 142p. Dep. NTIS, PC A07/MF A01.

As various alternative energy technologies such as photovoltaics, wind, fuel cells, and batteries are emerging as potential sources of energy for the future, the need arises for development of suitable power-conditioning systems to interface these sources to their respective loads. Since most of these sources produce dc electricity and most electrical loads require ac, an important component of the required power-conditioning units is a dc-to-ac inverter. The discussions deal with the development of power conditioners for each alternative energy technology. Discussion topics include assessments of current technology, identification of operational requirements with a comparison of requirements for each source technology, the identification of future technology trends, the determination of mass production and marketing requirements, and recommendations for program direction. Specifically, one working group dealt with source technology: photovoltaics, fuel cells and batteries, and wind followed by sessions discussing system size and application: large grid-connected systems, small grid-connected systems, and stand alone and dc applications. A combined group session provided an opportunity to discuss problems common to power conditioning development.

54625 Transformers: gaining on the losses. Whitaker, R.; Norton, E. *EPRI J.;* 4: No. 6, 7-11(Jul 1979).

The need for research and development in transformer technology is demonstrated by cascading transformer power losses amounting to 4% and line losses of 11% between the power plant and the end user. Power line research, fire resistance, and cooling are all areas for potential cost savings and some environmental benefits. The major cost saving in transformer technology will be proportional to the generating and transmission capability needed to make up for the power loss. Loss evaluation requires complex calculation of losses in the wire windings and the core and of scale economies. New alloys of amorphous magnetic material may reduce core losses as much as 60% if they can be developed. Technological breakthroughs in fire-resistant coolants, better insulation, superconductivity, and other fronts will effect further savings if they also increase reliability.

54626 Dynamic braking control of electrical power systems. Rahimi, A. (Arya-Mehr Univ. of Tech., Tehran, Iran). pp 401-409 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

A dynamic brake is a resistor which can be switched on and off a generator or a bus in a power system during a transient. If appropriately installed and operated, it can dissipate the transient energy which would otherwise result in loss of synchronism in the system. Pontryagin's minimum principle is used to develop a feedback control law for switching such brakes to effect transient control. 6 references.

54627 Joint utility corridor and right-of-way practices of the Bonneville Power Administration. Eichin, P.E.; Hurless, H.D. (Bonneville Power Administration, Portland, OR). pp 8p, Paper A 76 163-6 of Text of A papers from the winter meeting of the IEEE Power Engineering Society. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE winter meeting; New York, NY, USA (25 Jan 1976).

The joint or multiple use of utility corridors and rights-of-way involves technical, environmental, social, economic, and legal factors. Also, under joint use, safe practices and power system reliability must be maintained. The Bonneville Power Administration (BPA) joint utility corridor and right-of-way practices were formulated in light of these complex requirements. Improved communication links between organizations are concluded by BPA to be a key factor in achieving mutually acceptable solutions to joint use problems. Major emphasis is placed here on discussions of the associated technological considerations for minimizing ac and dc power system influence to other facilities. The effects on specific utlity and transportation systems are briefly discussed.

AC SYSTEMS, EHV AND UHV

54628 (DOE/ERD—0017) **Environmental Readiness Document: utility transmission.** (Department of Energy, Washington, DC (USA)). Aug 1979. 37p. Dep. NTIS, PC A03/MF A01.

This Environmental Readiness Document was prepared to assist DOE in evaluating the commercial readiness of utility transmission technology with respect to environmental issues. An effort has been made to identify potential environmental problems that may be encountered based upon current knowledge, proposed and possible new environmental regulations, and the uncertainties inherent in planned environmental research.

54629 (DOE/ET—2061-1) **Study to determine the basic insulation level requirements for a prototype 1200 kV CGIT cable system.** Cooper, J.H. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Jul 1979. Contract EX-76-C-01-2061. 30p. Dep. NTIS, PC A03/MF A01.

The required lightning impulse withstand characteristics of a prototype 1200 kV CGIT System were studied. It was assumed that lightning overvoltages would be introduced into the CGIT System due to lightning strokes which terminate on the overhead transmission system connected to the CGIT system. A detailed analysis of several proposed configurations for 1100 to 1200 kV transmission lines indicated that the most probable form of lightning overvoltage introduced into the CGIT System would be caused by shielding failures rather than blackflash occurrences. Following this conclusion, a single phase digital transient program was utilized to calculate the transient overvoltages which would appear within the CGIT System for system lengths of 600 ft, 2 miles, 10 miles, and 50 miles. Part of these simulations modeled surge arresters at both ends of a CGIT System representing a cable system interposed in an overhead line or a cable system terminating at an air-insulated substation. A second group of computer simulations modeled a surge arrester at one end only to represent the situation where a CGIT System terminates at a gas insulated station where the disconnects are opened and no arrester is applied within the gas insulation. Two types of surge arresters were modeled in this study: an arrester having protective characteristics extrapolated from present designs and ceramic oxide arresters.

54630 (EPRI-EL—1047-SR, pp 2.1-2.30) **Static VAR compensation: ten years of experience of design and operation using saturated reactors.** Thanawala, H.L.; Williams, W.P.; Young, D.J. (GEC Power Engineering Ltd., Stafford, England). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

Experience of the General Electric Company Limited of England (GEC) in the application of saturated reactors for static var system is reviewed. Particular emphasis has been placed on four

transmission SVS installations out of the total of nearly 25 commissioned during the past ten years. These cover applications for the receiving end of a long transmission line, for a system interconnection point, for a large pulsed-load connected to a transmission system and for multi-SVS compensation of a long weak transmission line. The success of these installations was helped by the interplay that took place between the utilities or consultants and the manufacturer at the planning/design stage. These discussions clarified the differing features of synchronous compensators and of several types of SVS. They also defined the continuous var ranges and overload requirements of the SVS, the required response to transient system overvoltages and resulting SVS overcurrents, the permissible system and SVS harmonics and the reliability and maintenance features. The highly satisfactory service experience of the GEC equipment has clearly demonstrated the suitability of harmonic compensated saturated reactors for control of system voltage and var flow. The equipment has been reliable in service, even under unexpected transient and overload conditions, and free from major maintenance requirements.

54631 (EPRI-EL—1047-SR, pp 3.1-3.21) **Static VAR Sources, their alternatives and use in transmission systems.** Schweickardt, H.E. (BBC Brown, Boveri and Co. Ltd., Baden, Switzerland). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

Static VAR Sources (SVS) are increasingly employed in EHV transmission systems and in industrial plants. A table illustrates many possible compensation alternatives which are available for such applications, including the synchronous condenser. The largest SVS concept in the world for transmission lines, at present being commissioned, is described. Regulator aspects are discussed to a great detail. Oscillograms showing the response to be expected are included.

54632 (EPRI-EL—1047-SR, pp 4.1-4.15) **Hydro-Quebec's experience in planning, designing, and implementing static compensation systems.** Czech, P.; McGillis, D. (Hydro-Quebec, Montreal). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

A short history is presented of the development of the Hydro-Quebec transmission system and the evolution of dynamic shunt compensation as the cornerstone of this system. The design criteria of a shunt-compensated system and the role of static compensators in such a system are discussed. The first model studies made on static compensators at IREQ and the more elaborate studies that are still going on are summarized. The performance of the first static compensator installation is described as are the plans for future installations associated with the James Bay transmission system.

54633 (EPRI-EL—1047-SR, pp 5.1-5.32) **Basics of applying static VAR systems on HVAC power networks.** Hauth, R.L.; Moran, R.J. (General Electric Co., Schenectady, NY). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

The characterization of a static var system (SVS) in terms of its steady state V-I characteristic is restated from the literature and extended to permit a more thorough understanding of its operation on an HVAC power system. The fundamental frequency, balanced three phase dynamic behavior of the SVS is described with the aid of simulation results and this performance discussed also in terms of the previously derived steady state characteristic. The key benefits of using an SVS for voltage control and system stabilization are discussed with the aid of simulation results. Finally, suggestions are made regarding what studies should be conducted by the utility planner in preparation for an SVS application.

54634 (EPRI-EL—1047-SR, pp 6.1-6.13) **Planning, installation, and initial operation of the Victory Hill Static Var Control.** Davis, W.L. (Basin Electric Power Cooperative, Bismarck, ND); Newell, R.J.; Doudna, J.H. Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

The Victory Hill Static VAR Control (SVC) was installed at the Nebraska Public Power District Victory Hill 230/115 kV Substation located near Scottsbluff, Nebraska. The planning and installation details used for the facility are described and the initial operation phase is reported. Operating problems and modifications which have ben made since initial energization are also discussed.

54635 (EPRI-EL—1047-SR, pp 7.1-7.31) **Transmission static VAR generator installation description and performance results.** Lordeon, W.J.; Cronin, J.H.; Cooper, R.; Brennan, M. (Westinghous Electric Corp., East Pittsburgh, PA). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

The installation and performance of the EPRI/MP and L/Westinghouse Static VAR Generator project are reviewed. The control performance results of the automatic voltage regulator (AVR) are discussed in view of the dynamic response of the Static VAR Generator. Two types of AVR control are discussed, individual phase voltage control, and three phase average voltage control.

54636 (EPRI-EL—1047-SR, pp 8.1-8-16) **Application of a static VAR system to the MP and L transmission network.** Bahrman, M.P.; Crane, L.P.; Nylander, F.L.; Parenteau, R.J.; Wood, C.E. (Minnesota Power and Light Co., Duluth). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

The application of a static VAR system for reactive support on the MP and L transmission network is discussed. System requirements and static VAR system design considerations are reviewed. Performance tests and operational experience are summarized. Conclusions and considerations for future applications are outlined.

54637 (EPRI-EL—1047-SR, pp 9.1-9.7) **Light triggered thyristors and their application to thyristors switches in static VAR generators.** Hanes, M.H.; Page, D.J. (Westinghouse R and D Center, Pittsburgh, PA). Apr 1979.

From Transmission static VAR systems seminar; Duluth, NM, USA (24 Oct 1978).

The use of light triggered thyristors in high voltage stacks can result in equipment cost savings. The design of light triggered thyristors, suitable optical systems, and the performance of light triggered switches are described.

54638 (EPRI-RP—7810-1) **Development of 500 KV AC cable employing laminar insulation of other than conventional cellulosic paper. Final report.** Bahder, G.; Eager, G.S. Jr.; Walker, J.J.; Dima, A.F. (General Cable Corp., Union, NJ (USA)). Aug 1978. Contract EX-76-C-01-1426. 133p. Dep. NTIS, PC A07/MF A01.

Results are presented of an investigation to develop a 500 kV ac laminar dielectric power cable and joint having insulation with lower losses than conventional cellulosic paper insulation. Background information is presented on proposed low-loss synthetic and composite synthetic/cellulosic paper insulations and experiments covering a period of 20 years. Two types of insulations were chosen from these studies: fibrous polypropylene paper tape and cellulosic paper-polypropylene film-cellulosic paper composite paper (PPP). Extensive testing of hand-wrapped cable models fabricated with each type of tape served to eliminate from further consideration the fibrous polypropylene paper tape. Cable model tests indicate that the PPP tape is satisfactory for insulation in 500 kV ac cable, that oil impregnants now used in conventional cellulosic paper insulated cables are unsuitable for both types of the above insulation, but that silicone oil with an additive is satisfactory for PPP tapes. Laboratory data taken on three full-size factory-made prototype pipe-type cables and on a prototype joint indicate PPP insulation is suitable for 500 kV ac operation. Four final pipe-type cables having conventional moisture seal were manufactured for possible future field testing. The dielectric loss of the final cables is 1/5 that of conventional cellulosic paper insulated cables. The estimated installed cost per MVA-mile of the PPP insulated cable, neglecting the cost of losses, is higher than cellulosic insulated cables impregnated with conventional mineral oil. However, the reactance necessary to compensate for the cable charging current is significantly reduced. The design of a pipe-type cable and joint developed in this project and the PPP insulation structure are suitable for self-contained oil-filled cable systems rated 500 kV ac operating at reasonably high oil pressure.

54639 **765 kV insulation coordination: uranium enrichment gaseous diffusion plant.** Underwood, D. (Energy Research and Development Administration, Oak Ridge, TN); Griffard, W.F. pp 8p, Paper A 76 150-3 of Text of A papers from the winter meeting of the IEEE Power Engineering Society. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE winter meeting; New York, NY, USA (25 Jan 1976).

Considerations necessary to properly select basic insulation level (BIL) values for a 765 kV power supply to a modern uranium enrichment gaseous diffusion plant are presented. Consideration is given to engineering information that must be evaluated to properly select surge arrester rating, equipment BIL and substation clearances. Based on certain assumptions relative to the power supply systems, recommendations are made of suggested values for BIL and clearances.

DC SYSTEMS

REFER ALSO TO CITATION(S) 54628

54640 **Proceedings of the symposium on HVDC power transmission.** Portland, OR; Bonneville Power Administration (1976). 365p. (CONF-7604151—).

From Symposium on HVDC power transmission; Leningrad, USSR (7 Apr 1976).

The conference proceedings discuss operating experience of ehv and uhv dc power transmission lines. The following topics are

discussed: (1) environmental effects on electrical insulation voltage breakdown; (2) conductor selection with reference to corona discharges and electric field effects; and (3) electrical protection of the lines due to switching surges and lightning. A separate abstract was prepared for each of the 12 papers presented at the conference.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

54641 **Electromechanically driven and tuned vibrations in superconducting alternators.** Keim, T.A.; Thullen, P.; Shevchuk, G.J. (Massachusetts Inst. of Tech., Cambridge). pp 8p, Paper A 76 123-0 of Text of A papers from the winter meeting of the IEEE Power Engineering Society. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE winter meeting; New York, NY, USA (25 Jan 1976).

Open-circuit, short-circuit, and synchronous condenser tests have been performed on a 3-MVA alternator having a superconducting field winding. These tests have revealed electromagnetically driven vibrations of the electrothermal shield. A shield of this type is an important part of most proposed superconducting alternator designs. The observed vibrations have been severe enough to significantly degrade the effectiveness of the electrothermal shield. Experimental observations, analysis of the sources of the magnetic forces, which drive the vibrations and of the shield's response to these forces, are presented. A proposed repair for the 3-MVA experimental machine is described. The importance of these vibrations in subsequent superconducting machines is discussed.

NUCLEAR POWER PLANTS

54642 (SRO—0947-T2) **Study of advanced professional educational requirements relative to nuclear fuel cycle engineering in industry and government. Quarterly report, April 1, 1979-June 30, 1979.** Jur, T.A. (South Carolina Univ., Columbia (USA)). Aug 1979. Contract EY-76-S-09-0947. 29p. Dep. NTIS, PC A03/MF A01.

The purpose of this project has been to develop a response to the educational needs of engineers working in the southeast's nuclear industry. The first phase of the project, now complete, was a study to assess the nature of the educational need. The second phase was intended to implement a program to meet those needs. Due in part to continued reorganization within DOE a proposal for implementation was never acted upon. DOE did however approve application of residual funds from the study phase to a modest initiation of implementation activity. Work is now underway in the development of educational packages in two subject areas: The Nuclear Fuel Cycle and The Metallurgy of Stainless Steel and Nickel-Base Alloys.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 54667, 54852, 54856, 54879, 54880, 54886, 54917, 54918, 54919, 54920, 54921, 54922, 54936, 54945, 54949, 54960, 54978, 54979, 54980, 54992, 54999

54643 (INIS-mf—4506, pp vp) **Stress analysis of a MCP pressure vessel nozzle.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this paper is to discuss the different stress analysis methods applied at various stages during design work on a complicated nozzle for a BWR-vessel, and to compare these methods with each other and with experimental results obtained from measurements on the vessel during proof testing. Conclusions are presented regarding the general approach applied and the validity of the different methods. These conclusions will be valid for components possessing some similarity with the present structure. The component dealt with is the nozzle for the main circulation pumps in the pressure vessel of the ASEA-ATOM BWR. In all 8 nozzles are located at the bottom of the vessel; they are equally spaced near the outer diameter of the vessel. The vertical nozzles penetrate the vessel wall in the transition zone between the spherical bottom and the cylindrical vessel wall. The angle between the nozzle axis and the conical and toroidal transition zone is 45°. The nozzle itself possesses rotational symmetry as it consists of two concentric cylinders, connected to each other by welding inside the vessel. However, the connection between nozzle and vessel wall is not axisymmetric. Results from the following stress analysis are presented and compared: axisymmetric calculations on the undisturbed vessel bottom (without nozzle); axisymmetric calculations on a simplified nozzle in a sphere (shell and solid ring elements); axisymmetric finite-element calculations on a nozzle in a thick plate; three-dimensional finite-element calculations of the nozzle and the lower part of the vessel; strain-gauge measurements on the nozzle and the vessel during proof testing.

54644 (INIS-mf—4506, pp vp) **Axisymmetrical model for nozzle on cylindrical shell and comparison with experimental results.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In the stress analysis of a reactor pressure vessel and especially of a boiling water reactor, one of the largest jobs is the transient stress and fatigue analysis of the nozzles. In fact, there are several different types of nozzles on the cylindrical shell and for each one, many transients of temperature and pressure are usually specified. It results that many stress calculations on nozzles are necessary in the stress analysis of such a vessel. The size of the problem does not allow to use tridimensional programs due to the computer time they require. It becomes necessary, hence, to use a bidimensional model which can give satisfactory results. The two classical models are the nozzle-on-sphere and the nozzle-on-plate. The former, certainly simpler as regards the boundary conditions, will be examined first. Its results, compared with the experimental data, are not satisfactory especially in the nozzle-to-vessel transition zone where the greatest peak stresses are located. The nozzle-on-plate model will be then examined. The stresses in a nozzle on cylinder are simulated with a radial force and a circumferential shear force applied at the outside boundary of the plate and expanded in Fourier's series whose zero and second harmonics are considered. The axial stresses in the nozzle are produced by an axial force and the circumferential stresses by the internal pressure. Firstly, the theoretical combination of these loads is examined, then several other combinations with different relative values of the loads and different application points of the axial force were studied and the most significant ones are here presented and compared with the experimental results. At last, the best combination was chosen and verified on the recirculation outlet nozzle.

54645 (INIS-mf—4541, pp vp) **Experimental analysis of dynamic behavior of pipe restraints under pipe whip accident conditions.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper reports the main features and results of numerous impact tests performed on stainless steel full scale U-shaped pipe restraints, under conditions simulating real pipe whip accident consequent to the guillotine rupture of a large diameter pipe (22") in a LWR cooling system. Relevant aims of the above mentioned research have been to: confirm with full-scale tests the soundness of a design based on material characteristics data obtained with standard tests; check if material energy absorption characteristics are affected by possible critical impact speed, strain rate or scale effects; demonstrate that tested restraints are capable of confining the pipes in real accident conditions with suitable safety factors for allowable impact energy and strain level. In order to simulate real accident conditions, as regard to pipe impact speed and total energy, an over 50 m high drop tower was built and used. This tower was furnished with hammer, the weight of which could be varied from 300 to 1250 kg. This hammer was guided inside the tower onto the testing restraints by means of two rails and had a cylindrical head with the same diameter of the pipe to be restrained. During the tests, carried on with increasing hammer weights up to restraint breaking off, measurements were taken of absorbed energy, hammer impact speed, deflection versus time, residual percentual strain along the restraints, and dynamic load on restraints legs during impact. On the basis of experimental results analysis it has been possible to attain information on relation between restraint end displacement and impact energy, variation of strain along straight share and bends of restraints, and, through displacements versus time law, on material dynamic behavior in testing conditions. Design criteria and safety factors applied appeared satisfactory and conservative enough.

54646 (INIS-mf—4541, pp vp) **Steamhammer in main steam piping systems.** 1977. (In German).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Experience showed that pressure and momentum transient conditions generated by sudden valve opening or/and closure can lead to large amplitude vibrations and damage of the piping systems. In the particular case investigated here, the supports and the snubbers of the main steam piping of a BWR power plant were damaged. This paper presents the mathematical model that has been used in the calculation of the pressure, specific weight and velocity transients in a main steam piping system. The one-dimensional steam flow has been described by means of two partial differential equations and an algebraic relationship: continuity, momentum, the isentropic relation between pressure and density. The numerical solution of the differential equations requires a space and a time discretization. For the time discretization a Runge Kutta numerical integration method has been chosen. The space discretization has been made in two steps. First the piping system was divided into a number of discrete legs of

constant diameter. The end points of the legs or their junctions were represented by valves, thrushes and volumes. The second step was to divide the legs themselves into two finer discrete parts. The piping system has been considered to consist of straight rigid and horizontal pipe legs, single volumes and valves. A linear steady state pressure drop is assumed over the whole length of the piping. The extra pressure drop across the pipe bends and T pieces is neglected. For the valves, an isentropic nozzle flow was assumed. To approximate the pressure behavior downstream from the stop valve, the turbine was modelled as a single volume. For the bypass valves, connected to the condenser, a choked flow was assumed. The calculations have shown that the highest pressure differences occur in the legs leading to the bypass valve and to the turbine.

54647 (INIS-mf—4541, pp vp) **Towards an elastic-plastic fracture mechanics predictive capability for reactor piping.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54648 (INIS-mf—4638, pp vp) **New approach to suppression pool hydrodynamics.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54649 (INIS-mf—4638, pp vp) **Analysis of steam vent clearing loads on the suppression pool.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54650 (INIS-mf—4638, pp vp) **Fluid-solid interaction by finite element techniques.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54651 (NUREG/CR—0818) **Heavy-Section Steel Technology Program. Quarterly progress report, January-Marcn 1979.** Whitman, G.D.; Bryan, R.H. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 127p. (ORNL/NUREG/TM—324). Dep. NTIS, PC A07/MF A01.

The Heavy-Section Steel Technology (HSST) Program is an engineering research activity conducted by the Oak Ridge National Laboratory (ORNL) for the Nuclear Regulatory Commission (NRC). The program comprises studies related to all areas of the technology of the materials fabricated into thick-section primary-coolant containment systems of light-water-cooled nuclear power reactors. The principal area of investigation is the behavior and structural integrity of steel pressure vessels containing cracklike flaws. Current work is organized into six tasks: (1) program administration and procurement; (2) fracture mechanics analyses and investigations; (3) effect of high-temperature primary reactor water on the subcritical crack growth of reactor vessel steels; (4) investigations of irradiated materials; (5) pressure vessel investigations; and (6) thermal shock investigations. A user-oriented finite-element computer program for calculating mixed-mode stress-intensity factors (SIFs) for nozzle corner flaws of arbitrary shape is being developed. A method for estimating stable crack growth in fracture toughness specimens was developed and applied to the analysis of several sets of data. Fatigue tests with ramp loadings indicate a need for further study of saturation with decreasing frequency or ramp time. Preparations continued for testing the second series of irradiated fracture toughness specimens and for irradiating the fourth series. Posttest calculations of the SIFs for both crack initiations in vessel V-8 agree well with test data. In preparing for the first cryogenic thermal shock test, a shakedown test of the facility was successfully conducted with liquid nitrogen.

54652 **Potential uses of high gradient magnetic filtration for high-temperature water purification in boiling water reactors.** Elliott, H.H.; Holloway, J.H.; Abbott, D.G. (General Electric Co., Pleasanton, CA). pp 127-133 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Studies of various high-temperature filter devices indicate a potentially positive impact for high gradient magnetic filtration on boiling water reactor radiation level reduction. Test results on in-plant water composition and impurity crystallography are presented for several typical boiling water reactors (BWRs) on plant streams where high-temperature filtration may be particularly beneficial. An experimental model on the removal of red iron oxide (hematite) from simulated reactor water with a high gradient magnetic filter is presented, as well as the scale-up parameters used to predict the filtration efficiency on various high temperature, in-plant streams. Numerical examples are given to illustrate the crud removal potential of high gradient magnetic filters installed at alternative stream locations under typical, steady-state, plant operating conditions.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 54645, 54651, 54852, 54856, 54875, 54876, 54879, 54880, 54881, 54882, 54883, 54884, 54886, 54887, 54888, 54889, 54897, 54899, 54901, 54902, 54918, 54923, 54924, 54925, 54926, 54944, 54973, 54976, 54977, 54978, 54979, 54980, 54982, 54987, 54988, 54992, 54995, 54997, 54999, 55017, 55020

54653 (CONF-791103—30) **Natural circulation steam generator model for optimal steam generator water level control.** Feeley, J.J. (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1979. Contract EY-76-C-07-1570. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Several authors have cited the control of steam generator water level as an important problem in the operation of pressurized water reactor plants. In this paper problems associated with steam generator water level control are identified, and advantages of modern estimation and control theory in dealing with these problems are discussed. A new state variable steam generator model and preliminary verification results using data from the loss of fluid test (LOFT) plant are also presented.

54654 **Sbornik IV. (Proceedings of the IV).** Nemec, J. (ed.). Prague, Czechoslovakia; Statni pedagogicke nakladatelstvi (1977). vp. (In Czech). (CONF-7706185—P1).

From 4. scientific conference of the Czech Technical University; Prague, Czechoslovakia (7 Jun 1977).

Separate abstracts were prepared for the individual papers included in the proceedings.

54655 (INIS-mf—4506, pp vp) **Research programme sponsored by CEA concerning the failure probability. Calculation of a PWR vessel.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54656 (INIS-mf—4506, pp vp) **Three-dimensional computations for stress and strain analysis of a PWR pressure vessel.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54657 (INIS-mf—4506, pp vp) **Fracture mechanics method of evaluating structural integrity of a reactor vessel due to thermal shock effects following LOCA condition.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The paper encompasses criteria underlaying a fracture mechanics method of analysis to evaluate structural integrity of a typical 950 MWe PWR vessel as a result of very drastic changes in thermal and mechanical stress levels in the reactor vessel wall. The main object of this investigation therefore consists in assessing the capability of a PWR vessel to withstand the most critical thermal shock without impairing its ability to conserve vital coolant owing to probable crack propagation. The principal evaluation has been based on predicting nominal values of vessel parameters which are significant to the functional results. These parametric coefficients essentially consist of heat transfer coefficient at the inside wall, the 'NVT' incidence on the inside wall, the fracture mechanics model of the vessel wall and the fracture toughness of the vessel material. In addition, the effects of degree of conservation in these parameters on the outcome of the final solution were also examined. The complete procedure for this type of analytical approach demands an overall investigation of four general areas consisting of: LOCA analysis, thermal and hydraulic analysis, mechanical, residual and thermal stress analysis and finally failure mode analysis involving ductile yielding, fatigue as well as brittle fracture. In each mode of investigation, it is intended to evaluate significant parameters to be utilized in undertaking Linear Fracture Mechanics (LFM) method of analysis.

54658 (INIS-mf—4506, pp vp) **Pressure induced stresses in the upper part of a PWR vessel, using photoelastic and 3D finite element methods.** 1977. (In French).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A three-dimensional finite element analysis of the stresses in the upper part of a PWR vessel would represent a formidable task. Thus, it is of common practice to carry out a separate analysis of the various items (flanges, nozzles, head ...) and to use approximate modelling techniques to reduce the computational effort. By doing this, it is not possible to assess the stress concentration effects and to appreciate the interaction between two elements. The need for more complete studies is evident in order to provide guidelines for the methods commonly used in stress reports. A comprehensive study of the pressure induced stresses in the upper half of a 3-loop PWR

vessel was undertaken to satisfy this need by using an epoxy 0.1 scale model. With this model it is possible to represent the six nozzles, the two flanges, the spherical head, the studs and the holes in the flange and in the head. Prestressing in the studs is obtained through the use of helicoidal springs. The experimental technique is the so-called 'frozen stress' method. The model is heated to 110°C, pressure being kept at a constant value of 0.01 MPa with an adequate regulation device. After cooling of the model to room temperature, many slices are cut out of the model and analyzed by new photoelastic techniques. Every point of interest (studs, penetrations in the head and in the flange, discontinuity stresses at the junction between nozzle and vessel, ...) has been analyzed by an automatic method giving immediate knowledge of the deviatoric stress tensor. The results are compared with those of a three-dimensional finite element analysis of the head submitted to the combined action of pressure and stud reactions in order to make an assessment of the computational stress intensification .

54659 (INIS-mf—4541, pp vp) **Synthesis of vibration studies on a three loop PWR internals model.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The flow induced vibrations problems are of complex nature. In the case of reactor internal structures, a study, based on a three loop PWR 1/8 internals model, the SAFRAN test model has been carried out. Methods and specific means of calculation were associated to this experimental tool, allowing thus the understanding of the phenomena and their extrapolation to the full scale reactor. Experimental tests in air, and in still water were carried out, to determine structure frequencies, mode shapes and generalized coefficients. Flow tests were made to measure the random response of internal structures, and to get information about the fluctuating pressure field acting on the system. The evaluation of the unperturbated pressure field and the calculation of the structures response, submitted to the flow forces, have been made by using the experimental results, the VIBRAPHONE acoustic program, and a tridimensional mechanical system taking into account local connections between shells and water interactions, i.e. AQUAMODE and TRISTANA system. The extrapolation to the prototype and the comparison with experimental results obtained on the FESSENHEIM 1 reactor internals were made. The extrapolated data are in very good agreement with the real reactor values.

54660 (INIS-mf—4541, pp vp) **Crack growth rate analysis in PWR reactor piping.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Crack growth on PWR reactor primary circuit pipings is the subject matter of the Aquitaine-1 Program. This program includes an experimental part on piping elements made of stainless steel AISI 316 L, scale 1/4 of primary pipings. These pipings are subject to cyclic variations of cold pressure, then to 290°C in water, utilizing a specific test loop. At 290°C the pressure variations are between the atmosphere and 160 bars at 4 cycles/hr. The experimental part constitutes a realistic approach of phenomena pertaining to defects propagation in actual operating conditions. A first phase consisted of characterizing the material. The speed of cracking was determined on test-piece CT in the various environment conditions: air 20°C, air 320°C, water 320°C. Furthermore, an evaluation of the influence of the cycling frequency on that speed had been made. Three measurement methods for the crack depths are utilized: a method by electrical potential, ultrasonic technics. The estimate of the stress intensification factor was performed through various ways. Calculations related to finite elements in elastoplasticity with the Pastel Code were carried out for a number of infinite length internal and external crackings. An elastic calculation in tridimensional geometry with the Bilbo Program was made for a finite length crack. A comparison was made with the obtained results with the weight functions. Furthermore, for finite cracks, there was reliance upon formulae found in published literature. First results were obtained on axial cracks with infinite length and 20 to 3 ratio for notch length on wall thickness. All the notches had an initial depth equal to half of the thickness. Cracks aspects are examined through microfractography. Comparison is performed between the experimental results and forecastings of growth speed resulting from the characterization of material and calculations of fracture mechanics.

54661 (INIS-mf—4541, pp vp) **Inelastic analysis of finite length and depth cracked tubes.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Steam generator tube failure can at times result in reactor safety problems and subsequent premature reactor shutdowns. This paper concerns itself with the prediction of the failure pressures for typical PWR steam generator tubes with longitudinal finite length and finite depth cracks. Only local plastic overload failure is considered since the material is non-notch sensitive. Non-linear finite element analyses are carried out to determine the burst pressures of steam generator tubes containing longitudinal cracks located on the outer surface of the tubes. The non-linearities considered herein include elastic-plastic material behavior and large deformations. A non-proprietary general purpose non-linear finite element program, NFAP was adopted for the analysis. Due to the asymmetric nature of the cracks, two-dimensional, as well as three-dimensional finite element analyses, were performed. The two-dimensional element and its formulations are similar to those of NONSAP. The three-dimensional isoparametric element with elastic-plastic material characteristics together with the large deformation formulations used in NFAP are described in the Report BNL-20684. The numerical accuracy of the program was investigated and checked with known solutions of benchmark problems. In addition to the three-dimensional element which was specifically inserted into NFAP for this problem, other features such as direct pressure inputs for isoparametric elements, automatic load increment adjustments for convergent non-linear solutions, and automatic bandwidth reduction schemes are incorporated into the program thus allowing for a more economical evaluation of three-dimensional inelastic analysis. In summary the analysis clearly shows that for short cracks axial effects play a significant role. For long cracks, they are not important since two-dimensional conditions predominate and failure is governed by circumferential or hoop stress conditions.

54662 (INIS-mf—4543, pp vp) **Inelastic analysis of overall shakedown phenomenon in nozzles subjected to one or two loading parameters.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

By an elastic perfectly plastic calculation using the F.E. method, we study on two nozzles the concept of overall shakedown. We give a definition of the Δpsub(g) limit and compare it with the 3Ssub(m) rule. In the first part we analyze a radial nozzle in a spherical shell with only one loading parameter (internal pressure p). The Ksub(e) ratio was calculated for eight types of cycles corresponding to a wide range of psub(max) and Δp. The results show that Δpsub(s) corresponding to Ksub(e)=1 is dependent on psub(max), but as soon as Ksub(e) becomes greater than 1 there is a unique relationship between Ksub(e) and Δp. This feature allows us to define the Δpsub(g) limit by Ksub(e)<=1+α, where α will be given function of the accuracy desired in the fatigue analysis on an elastic basis. With α=0.1 Δpsub(g) is 23 to 35% higher than Δpsub(s). The 3Ssub(m) rule of ASME code is more conservative. In the second part we analyze in the same way an other nozzle geometry reproducing a PWR configuration. In the third part we analyze the first nozzle under a loading depending on two parameters: the internal pressure p and an axial load f pulling or pushing the nozzle. The Ksub(e) factor is calculated for radial, triangular and rectangular loading paths in the p, f plane, admissble with respect to the ASME 3Ssub(m) rule. For a given Δp, Δf, independency of Ksub(e) with respect to loading path is checked.

54663 (INIS-mf—4638, pp vp) **2D fluid flow in the downcomer and dynamic response of the core barrel during PWR blowdown.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

As a part of the HDR program, methods for coupled fluid-structural dynamics are being developed. On the fluid side the 2D finite difference code YAQUI has been modified (it became YAQUIR) and adapted to describe the fluid dynamics in the downcomer of PWR's. On the structural side for determination of the dynamic core barrel response the code CYLDY2 has been developed. In this code the core barrel is treated as a thin cylindrical shell fixed at the upper end and ring stiffened at the lower end. The mass of the lower end ring also simulated a part of the core mass. Both models have been successfully tested. Coupling has been achieved for a simplified structural model proving the correctness of the coupling procedure. The structural model CYLDY2 is based on Fluegge's shell equations and uses variational principles. The solution is a superposition of steady-state and transient eigenfunctions. Results indicate that for the relatively thin-walled core barrel of the HDR-experiments in most cases the local deformations are somewhat higher than the global deformation (beam model). The coupling of YAQUIR and CYLDY2 is performed by imbedding the structural model in the fluid model. Fluid velocities are parallel to the fluid/structure interface. The structure desplacements define the time and space dependent thickness of the two-dimensional fluid layer (2 1/2-dimensional model).

54664 (INIS-mf—4639) **Effect of hydroelastic coupling on the response of a nuclear reactor to ground acceleration.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

An analytical and experimental study of the effects of hydroelastic coupling on the seismic response of a reactor vessel and its internal components is presented. The hydrodynamic mass matrix for cylindrical shell structures with arbitrary D/ratios, boundary conditions and mode shapes is derived. This hydrodynamic mass

matrix is real and symmetric with positive diagonal elements (virtual masses) and negative off-diagonal elements (coupling coefficients). Numerical results, which have been confirmed experimentally, show that: (1) for cylindrical shell structures with D/ratio typical of what is encountered in a reactor, Fritz's formula, in spite of its wide acceptance, overestimates the hydrodynamic mass for beam-mode response by more than a factor of two in most cases. (2) The hydrodynamic masses are not sensitive to the boundary conditions or local irregularities of the structure. Therefore, the expessions can be applied to cylindrical shell structure with non-classical boundary conditions and local irregularities. A procedure is suggested to incorporate the computed hydrodynamic mass matrix into existing finite element structural analysis computer codes for the seismic analysis of reaactor internal components. Two specific examples are included to illustrate the effect of hydroelastic coupling on the response of a PWR to ground acceleration. The first example is the coupled beam-mode response of the reactor vessel-reactor internal. The second example is the coupled shell-mode response of the core support cylinder and core basket.

54665 (INIS-mf—4651, pp 80-91) **Investigation of burn-up of the WWER-70 reactor fuel elements and assemblies by combining destructive and non-destructive methods.** Graber, Kh.; Kherman, A.; Baraniak, L.; Khofman, G.; Khyubener, Z.; Mener, Kh.Kh.; Nagel, Z.; Gyunter, Kh. 1977. (In Russian).

From 4. symposium on study into irradiated fuel reprocessing; Karlovy Vary, Czechoslovakia (28 Mar 1977).

Some experimental techniques of determining burnup have been investigated using spent fuel assemblies of the NPP "Rainsberg" WWER-70 reactor. 23 fuel elements were studied non-destructively using the γ-spectroscopic analysis, and 2 fuel elements were investigated destructively using the radiochemical analysis. Determined are the radial distributions of burnup in the fuel elements and axial distributions of burnup in the fuel assemblies, the latter having been determined by interpolation. The errors of the techniques amount to +-2 % for fuel specimens, +-4% for fuel elements and +-6% for fuel assemblies.

54666 (INR—1633/CYFRONET/PR/A) **Criticality calculations of selected Pu enriched light water lattices with wims and laser constants.** Andrzejewski, K.; Rida Gad Girgis. (Institute of Nuclear Research, Warsaw (Poland)). 1976. 27p. Available from Energetics and Atomic Energy Information Centre, Warsaw.

The results of 0,1 and 2 dimensional criticality calculations for selected plutonium enriched light water lattices are presented. Five square lattices (SAXTON) with 6.6%PuO_2 in UO_2 have been investigated. Six hexagonal lattices for CRITICAL APPROACH FACILITY with 8, 16 and 24%Pu-240 enrichment have been studied. The calculations were performed as a test of LASER and WIMS code performance for Pu bearing fuel.

54667 (NUREG/CR—0847) **Advanced two-phase flow instrumentation program. Quarterly progress report, January-March 1979.** Turnage, K.G.; Davis, C.E.; Leavell, W.H. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 43p. (ORNL/NUREG/TM—331). Dep. NTIS, PC A03/MF A01.

A series of two-phase, air-water tests performed in vertical upflow with advanced spool piece I and with conductivity proves obtained from Atomic Energy of Canada, Ltd. (AECL), is described. The behavior of the three-beam densitometer, turbine meter, and drag flowmeter is discussed in terms of two-phase models. Application of some two-phase mass flow models to the recorded spool piece data is made and preliminary results are shown. Velocity and void fraction information derived from the conductivity probes is presented and compared to velocities and void fractions obtained using the spool piece instrumentation. Preliminary results obtained with a vortex shedding meter in air-water, two-phase downflow are presented.

54668 **High-temperature strain measurements on the closure studs of reactor pressure vessels.** Joas, H. pp 879-885 of 6. Internationale Konferenz 'Experimentelle Spannungsanalyse'. Duesseldorf, Germany, F.R.; VDI-Verl. (1978). (In German)

From 6. conference on experimental stress analysis; Munich, F.R. Germany (18 Sep 1978).

High-temperature strain measurements have been carried out in different operating phases on two closure studs each of several reactor pressure vessels. The strains and stresses during instationary states (e.g. start-up) were of special interest. On the basis of the strains measured, it was to be proved that the calculation methods and boundary conditions on which the analytical investigation of the vessel is based are sufficiently accurate.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 54749, 54750, 54853, 54855, 54892, 54931, 54939, 54951, 54955, 54956, 54961, 54965, 54966, 54972, 54981

54669 (BMFT-FB-K—78-06) **Development project HTR-electricity-generating plant, concept design of an advanced high-temperature reactor steam cycle plant with spherical fuel elements (HTR-K).** (Bundesministerium fuer Forschung und Technologie, Bonn-Bad Godesberg (Germany, F.R.); Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.); Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.)). Jul 1978. 212p. (In German). Dep. NTIS (US Sales Only), PC A10/MF A01.

The report gives a survey of the principal work which was necessary to define the design criteria, to determine the main design data, and to design the principal reactor components for a large steam cycle plant. It is the objective of the development project to establish a concept design of an edvanced steam cycle plant with a pebble bed reactor to permit a comparison with the direct-cycle-plant and to reach a decision on the concept of a future high-temperature nuclear power plant. It is tried to establish a largerly uniform basic concept of the nuclear heat-generating systems for electricity-generating and process heat.

54670 (COO—2975-31) **Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report, January 1, 1979-March 31, 1979.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 19 Jul 1979. Contract EY-76-C-02-2975. 32p. Dep. NTIS, PC A03/MF A01.

This report presents the results of work performed from January 1, 1979 through March 31, 1979 on the Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. The objectives of this program are to evaluate candidate alloys for Very High Temperature Reactor (VHTR) Nuclear Process Heat (NPH) and Direct Cycle Helium Turbine (DCHT) applications, in terms of the effect of simulated reactor primary coolant (helium containing small amounts of various other gases), high temperatures, and long time exposures, on the mechanical properties and structural and surface stability of selected candidate alloys. Work covered in this report includes the activities associated with the creep-rupture testing of the test materials for the purpose of verifying the stresses selected for the screening creep test program, and the status of the simulated reactor helium supply system, testing equipment, and gas chemistry analysis instrumentation and equipment.

54671 (GA-A—15216) **Fort St. Vrain MEU program. Final report.** (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-052. 67p. Dep. NTIS, PC A04/MF A01.

This report documents the status of a progrm to insert a nonproliferation MEU/Th fuel cycle into Fort St. Vrain. The conclusions reached from core design and fuel cycle management studies are presented in detail. The report also presents the results of studies to provide a verified computer library of programs for use in design and analysis of MEU fuel for Fort St. Vrain; preliminry fuel performance models for the prediction of MEU fuel failure and safety evaluations; interim design data for Ag and Pu transport in MEU/Th fuel materials; and results of R/B studies on various MEU fuel kernels.

54672 (GA-A—15448) **Cooling tubes: monotonic and cyclic shear tests. Final report.** Pikckering, J.L. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-017. 97p. Dep. NTIS, PC A05/MF A01.

In the prestressed concrete reactor vessel (PCRV), cooling tubes are welded on the concrete side of the cavity liners. These cooling tubes are placed at pitches determined by the design temperature limits of the liner/concrete interface and are subject to shear loading resulting from prestressing, pressurization, temperature, and creep of the PCRV. This test program consists of both monotonic and cyclic testing of models simulating prototype cooling tube/concrete assemblies. The Phase III tests determined the stiffness characteristics and failure modes of four possible cooling tube configurations having round and square cross sections. A comparison with the previously obtained results of the Phase I and Phase II tests on 1-in. x 1-in. square tubes is also included.

54673 (GA-A—15476) **Investigation of stick-slip (chatter) phenomenon of HTGR thermal barrier attachment fixture sliding interfaces. Phase I test: Class A thermal barrier hardware and environment.** Middleton, A. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract AT03-76ET35300. 89p. Dep. NTIS, PC A05/MF A01.

This test program was performed to investigate if significant chatter (stick-slip) would occur at the thermal barrier sliding surfaces. Given such conditions, cyclic loads could be induced in the

thermal barrier attachment fixture and studs. A representative section of thermal barrier was tested with realistic HTGR temperature cycles in a high purity helium environment. No significant chatter was detected and there was no visible deterioration of the hardware after testing.

54674 (INIS-mf—4543, pp vp) **Comparisons of methods for creep-fatigue damage analysis of high temperature piping.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54675 (INIS-mf—4638, pp vp) **Fluctuating pressure forces acting on the hot gas duct of a high temperature reactor.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In the hot gas ducts of high temperature reactors high velocities ($70<u<200$ m/s) occur, as at the same time the primary circuit is pressurized ($40<p<60$ bar) the dynamic pressure forces have a high intensity. The aim of the present work is to measure the intensity of the fluctuating pressure generated in several differently shaped bends of the ducts according to its level and frequency. The dynamic pressure forces are caused by the velocity fluctuations of the flow (turbulent motion or flow separation phenomena). As it is well known flow separation occurs in bends and produces large eddies travelling downstream and generating pressure fluctuations. In the model tests four types of bends have been examined: circular bends of circular cross section (angle of deflection 90° and 180°, curvature ration $R/d=1,5$, $R/d=2,5$ and $R/d=5$); 90°-bends of segmental design; 90° bends, mitred; 90°-mitred, rectangular channel. For comparison the pressure fluctuations of the straight tube were also determined. The experiments were conducted in air, pressurized air and helium. The pressure fluctuations were measured by means of condenser microphones. The energy needed for the velocity fluctuations is taken from the flow in the form of a streamwise pressure loss, k being the fraction of the pressure drop necessary to supply the pressure fluctuations, the experiments have shown that k is constant for particular types of flow. For bends with small curvature ratios R/d, is k approximately 0.2. Flows with a pressure drop predominantly caused by friction are characterized by k approximately 1.0. These data hold for the ovrall rms-values of the pressure fluctuations. The experiments indicate that similar relationships also exist for discrete frequencies selected from the spectrum. The frequency spectrum is broad and exhibits no prevailing frequencies. The intensity of the pressure fluctuations considerably decreases in the frequency range $400<f<1000$ Hz.

54676 (INIS-mf—4638, pp vp) **Acoustic environment in large HTGRs.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54677 (INIS-mf—4905, pp 211-222) **Transmission electron microscopy studies of irradiated oxide films.** Gol'tsev, V.P.; Korotov, V.F.; Patokin, A.V.; Fedyushin, E.E. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Methods are chosen for the separation of oxide films from the samples of austenitic chromium-nickel steels irradiated in a reactive N_2O_4 system. Results are presented of the transmission electron microscope analysis (TEM) of the oxide films; the film structure and composition are discussed. It is shown that at low temperatures of 500-700 K cracking of oxide films occurs and the oxidation rate of stainless steels in N_2O_4 is determined by the oxide film strength. The considered TEM technique enables to study the formation of protective oxide films on core elements in gas cooled reactors.

54678 (INIS-mf—4910) **10 years of electricity generation with the pebble bed reactor of AVR. High-temperature reactor - a hot tip.** (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Duesseldorf (Germany, F.R.); Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.)). 17 Dec 1977. 18p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The interesting facts of AVR reactor design and operation are summarized in a popular way of presentation and illustrated by figures and diagrams.

54679 (INTAT—78-70) **Absorber. Status and development.** Dietz, W. (comp.). (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.); Kerntechnische Gesellschaft im Deutschen Atomforum e.V., Bonn (Germany, F.R.)). Aug 1978. 112p. (CONF-7711123—). Dep. NTIS (US Sales Only), PC A06/MF A01.

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

Separate abstracts have been prepared for items within the scope of the energy data base. (FS)

54680 (KFK—2716) **Structure of turbulent flow through a wall subchannel of a rod bundle with roughened rods.** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1978. 96p. Dep. NTIS (US Sales Only), PC A06/MF A01.

An experimental investigation was undertaken in order to obtain information on the transport properties of turbulent flow through a wall subchannel of a rod bundle with roughened rods and a smooth channel wall. Detailed measurement values were obtained on the distributions of mean flow velocity, intensity of turbulence in all directions and thus the kinetic energy of turbulence as well as the shear stresses perpendicular and parallel to the walls and of the wall shear stresses on the smooth wall. The rod bundle consisted of four parallel rods contained in a rectangular channel; the Reynolds number of this investigation was $Re=1.82 \times 10^5$. From the measurement values the eddy viscosities in the directions perpendicular and parallel to the walls were calculated. The results are compared with predictions calculated by the VELASCO code.

54681 (LA—7592-MS, pp 4.1-4.23) **High-temperature gas cooled reactors.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

Information is presented concerning HTGR design characteristics; fuel elements; coated fuel particles; environmental and safety aspects; and process heat applications.

54682 (TREE—1368) **Sodium removal from Hallam Reactor components.** Huntsman, L.K.; Meservey, R.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 60p. Dep. NTIS, PC A04/MF A01.

This report discussed the removal of sodium from major components of the Hallam Nuclear Power Facility. This facility contained the experimental ractor used to test the feasibility of sodium coolant. The Idaho Operations Office of the Department of Energy assigned EG and G Idaho, Inc., the task of carrying out this decontamination and decommissioning program at the Idaho National Engineering Laboratory (INEL). Since their shipment to the INEL from Lincoln, Nebraska in 1968, the Hallam Reactor components had been stored in inert nitrogen to prevent the sodium in the components from reacting with moisture in the air. The procedure used to react the sodium in the components and to decontaminate them is discussed. Problems and unusual occurrences in the decontamination and decommissioning process are also reported.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 54749, 54850, 54903, 54904, 54941, 54963, 55303

54683 (INIS-mf—4541, pp vp) **Flow-induced vibration analysis of heat exchanger and steam generator designs.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Tube and shell heat exchange components such as steam generators, heat exchangers and condensers are essential parts of CANDU (CANadian Deuterium Uranium) nuclear power stations. A flow-induced vibration analysis is presented. In cross-flow three basic flow-induced vibration excitation mechanisms are considered, namely: fluidelastic instability, forced vibration response due to random flow turbulence and periodic wake shedding (the first two mechanisms in both liquid and two-phase cross-flow). Periodic wake shedding has not been detected in two-phase flow but is possible in liquid flow. It is only significant for upstream tube rows. Random flow turbulence is he dominant excitation in both liquid and two-phase axial flow. These vibration excitation mechanisms and the dynamics of multispan tubes are formulated in a computer model. The model predicts tube vibration response and critical velocities for fluidelastic instability. A description of the model is given. The vibration analysis of a steam generator is outlined as an example. The parameters required to formulate the vibration excitation mechanisms are discussed. Periodic wake shedding excitation is formulated in terms of a Strouhal No. and a lift coefficient which is generally less than unity. Fluidelastic instability thresholds are related to dimensionless flow velocity and dimensionless damping for both liquid and two-phase cross-flow. Some statistical parameters to describe random flow turbulence excitation are deduced from experimental data. The power spectral density of the latter is related to a power of the flow velocity. The velocity exponent is roughly two for liquid flow and near unity for two-phase flow. For a given mass flux, the random excitation reaches a maximum at a steam quality of roughly 15%. Damping in two-phase flow is found to be at least four times greater than in liquid flow.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 54749, 54851, 54856, 54874, 54877, 54878, 54885, 54893, 54894, 54895, 54900, 54906, 54907, 54908, 54909, 54910, 54911, 54912, 54913, 54914, 54915, 54940, 54964, 54983, 54984, 54985, 54986, 54996, 55001, 55002, 55003, 55004, 55005, 55006, 55008, 55009, 55010, 55011, 55014, 55015, 55016, 55018, 55225, 55290, 55296

54684 (ANL-CT—79-18) **Testing of steam generator leak detectors on the high pressure test loop: interim report.** Koehl, E.R.; Smith, F.A.; McKee, J.M. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 63p. AT.

A small pumped loop was built and is being used to test LMFBR steam generator leak detectors and calibration equipment in sodium at 925°F and 180 psi, with excursions to 325 psi (planned CRBR operating conditions). Six hydrogen meters, four oxygen meters and a hydrogen injection coil have completed a year of operation in sodium with no mechanical failures. The calibration stability of the hydrogen meters has not been as good as expected and is the subject of continuing investigation. The hydrogen injection coil was found to be correctly sized for its intended function, on-line calibration of hydrogen meters in leak detector modules. Sodium hydroxide injections are being used to calibrate both hydrogen and oxygen meters. Essentially all of the hydrogen and oxygen in the hydroxide is promptly detectable at 925°F. Two nickel membrane designs and two ion-pump cathode materials are being tested on the six hydrogen meters.

54685 (ANL-CT—79-45) **Experiments on fluidelastic instability in tube banks subject to liquid cross flow. Part II. Mixed arrays.** Chen, S.S.; Jendrzejczyk, J.A.; Lin, W.H. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 298p. AT.

The work reported was performed as part of the design method development activity for curved tube banks under the Flow Induced Vibration Program included in US DOE/RRT Work Package: Engineered System and Components; Task: General Engineering Support (Task No. 00305). The objective is to provide an experimentally validated mathematical model for design evaluation of curved tube banks to avoid detrimental flow-induced vibrations. An extensive test program was carried out to establish the critical flow velocity as a function of various system parameters. The test program was divided into two phases: (1) rectangular tube arrays; and (2) mixed tube arrays. The results from the second-phase tests are presented.

54686 (ANL-CT—79-46) **FIC: a finite element code for calculating added mass and damping coefficients. User's manual.** Batill, S.M. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 60p. AT.

The purpose of this report is to provide a user's manual for a finite element code, written by C. I. Yang of ANL. The code is capable of calculating the hydrodynamic reactions on multiple interacting bodies undergoing simple harmonic motion. This report will document input requirements and discuss the program output. A sample data set and program listing are also included. It should be noted that the program has not been prepared for production applications but is intended for use as a research tool.

54687 (ANL-CT—79-49) **SCRAP: theory and modeling considerations.** Moran, T.J. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 28p. AT.

The theoretical basis for the FORTRAN IV computer code SCRAP is presented. Guidance for modeling fast reactor core structures with the code is included. Companion reports describe the FORTRAN source and input format and the theoretical basis for the fluid modeling used by the code. SCRAP is a research tool, not a production code, and this report should not be considered a user's manual.

54688 (BNL—25598) **Physics and feasibility study of the Fast-Mixed Spectrum Reactor concept.** Fischer, G.J.; Kouts, H.J.C.; Cerbone, R.J.; Shenoy, S.; Durston, C.; Ludewig, H.; Majumdar, D.; Segev, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790933—1). Dep. NTIS, PC A02/MF A01.

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Reactor physics and fuel cycle studies, coordinated with heat transfer and material science and structural analysis work has indicated the feasibility potential of the coupled Fast-Mixed Spectrum Reactor (FMSR) concept. This concept employs what are considered reasonable extrapolations of present fast breeder reactor technology to achieve a once-through-and-store reactor fuel cycle. Since the fuel cycle for this reactor is intended to use only natural or depleted uranium for its equilibrium feed, the resultant reactor would have excellent anti-proliferation characteristics. It would also extend utilization of natural uranium resources by a factor of about 15 relative to LWR reactors when on its equilibrium fuel cycle; startup requirements would of course reduce this factor.

54689 (CONF-790239—1) **Comparison of numerical results with experimental data for single-phase natural convection in an experimental sodium loop.** Ribando, R.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 45p. Dep. NTIS, PC A03/MF A01.

From Specialists' meeting on decay heat removal and natural convection in FBRs; Upton, Long Island, NY, USA (28 Feb 1979).

A comparison is made between computed results and experimental data for a single-phase natural convection test in an experimental sodium loop. The test was conducted in the Thermal-Hydraulic Out-of-Reactor Safety (THORS) facility, an engineering-scale high temperature sodium loop at the Oak Ridge National Laboratory (ORNL) used for thermal-hydraulic testing of simulated Liquid Metal Fast Breeder Reactor (LMFBR) subassemblies at normal and off-normal operating conditions. Heat generation in the 19 pin assembly during the test was typical of decay heat levels. The test chosen for analysis in this paper was one of seven natural convection runs conducted in the facility using a variety of initial conditions and testing parameters. Specifically, in this test the bypass line was open to simulate a parallel heated assembly and the test was begun with a pump coastdown from a small initial forced flow. The computer program used to analyze the test, LONAC (LOw flow and NAtural Convection) is an ORNL-developed, fast-running, one-dimensional, single-phase, finite-difference model used for simulating forced and free convection transients in the THORS loop.

54690 (CONF-790802—69) **Cumulative damage fraction design approach for LMFBR metallic fuel elements.** Johnson, D.L.; Einziger, R.E.; Huchman, G.D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The cumulative damage fraction (CDF) analytical technique is currently being used to analyze the performance of metallic fuel elements for proliferation-resistant LMFBRs. In this technique, the fraction of the total time to rupture of the cladding is calculated as a function of the thermal, stress, and neutronic history. Cladding breach or rupture is implied by CDF = 1. Cladding wastage, caused by interactions with both the fuel and sodium coolant, is assumed to uniformly thin the cladding wall. The irradiation experience of the EBR-II Mark-II driver fuel with solution-annealed Type 316 stainless steel cladding provides an excellent data base for testing the applicability of the CDF technique to metallic fuel. The advanced metal fuels being considered for use in LMFBRs are U-15-Pu-10Zr, Th-20Pu and Th-2OU (compositions are given in weight percent). The two cladding alloys being considered are Type 316 stainless steel and a titanium-stabilized Type 316 stainless steel. Both are in the cold-worked condition. The CDF technique was applied to these fuels and claddings under the assumed steady-state operating conditions.

54691 (CONF-790816—39) **Comparison of COBRA III-C and SABRE-1 (wire-wrap version) computational results with steady-state data from a 19-pin internally guard heated sodium-cooled bundle with a six-channel central blockage (THORS Bundle 3C).** Dearing, J.F.; Nelson, W.R.; Rose, S.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Computational thermal-hydraulic models of a 19-pin, electrically heated, wire-wrap liquid-metal fast breeder reactor test bundle were developed using two well-known subchannel analysis codes, COBRA III-C and SABRE-1 (wire-wrap version). These two codes use similar subchannel control volumes for the finite difference conservation equations but vary markedly in solution strategy and modeling capability. In particular, the empirical wire-wrap-forced diversion crossflow models are different. Surprisingly, however, crossflow velocity predictions of the two codes are very similar. Both codes show generally good agreement with experimental temperature data from a test in which a large radial temperature gradient was imposed. Differences between data and code results are probably caused by experimental pin bowing, which is presently the limiting factor in validating coded empirical models.

54692 (CONF-791103—7(Summ)) **Methodology for statistical determination of fuel intra-assembly flow mixing uncertainty.** Tang, Y.S.; Friedland, A.J.; Markley, R.A. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1979. Contract EY-76-C-15-2395. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

To account for calculational and experimental uncertainties in reactor thermal-hydraulic analyses, hot channel/spot factors are usually used. This paper presents the methodology used to determine

calculational uncertainty in the prediction of flow distribution between subchannels of LMFBR core assemblies. The flow distribution uncertainty may be caused by fabrication tolerance, distorted elements or inter-channel mixing.

54693 (ESG-DOE—13271) **Studies in the reduction of sodium carryover.** Horton, P.H.; Oliva, R.M. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 20 Jul 1979. Contract EY-76-C-03-0824. 71p. AT.

This study was undertaken to better define the mechanisms causing excessive carryover of sodium into the Clinch River Breeder Reactor Plant (CRBRP) - Ex-Vessel Transfer Machine (EVTM) chain hoist drive system. At the test temperature of 400°F, classical wetting of steels does not occur, but during development testing of the chain hoist drive system, apparent wetting was observed on the chain and other steel surfaces. Full scale and laboratory scale tests were used to study the wetting mechanism with emphasis on the influence of oxygen and moisture in the argon cover gas atmosphere. It was demonstrated that moisture enrichment of the atmosphere (tests were conducted at 50 ppM moisture) encourages adherence of sodium to the metal surfaces while oxygen enrichment showed no such effect.

54694 (ETEC-TDR—79-4) **Endurance testing of prototypic subscale inducer pump at SCTL.** Baker, R.S. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 26 Jul 1979. Contract EY-76-C-03-0700. 45p. AT.

A series of tests have been conducted in sodium on a prototypic subscale inducer pump designed by Atomics International. Pump operation has been successful. Testing consisted of three intervals totaling 2000-h.

54695 (FEI—739) **Ways of solving some engineering problems in arrangement of integral and loop type fast reactors.** Rineiskii, A.A.; Baklushin, R.P.; Ivanenko, V.N.; Klimov, S.A.; Mel'nikov, N.P.; Matveev, G.V.; Sobolevskii, R.G.; Tkachenko, S.B.; Ustinov, G.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1977. 21p. (In Russian). Dep. NTIS (US Sales Only), PC A03/MF A01.

A comparative analysis of currently-in-use and feasible arrangements of loop and integral LMFBR type reactors is given. The discussion is based on the designs of "in operation", "under construction" and "projected" reactors all over the world. The effects of the outlet coolant temperature, reactor unit power, maintainability and costs on the choice of the arrangement type are considered. Considered in greater details are the hydraulic schemes and problems of the integral reactor vessel attachment as well as problems of ensuring strength of pipe-to-vessel connections and localizing coolant leaks in the loop type reactors. There is no general consent over the superiority of one of the designs up to now. There are different opinions on the account in different countries, since both designs have its merits and shortcomings.

54696 (FFTF—2170-T1) **Experimental irradiation of fracture mechanics specimens in fast reactors. HEDL-6583.** (Westinghouse Hanford Co., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 22p. TIC.

Two LMFBR irradiation facilities are, or will be, providing the great majority of irradiation space in support of fracture mechanics characterization efforts: the Experimental Breeder Reactor-II (EBR-II), and the Fast Flux Test Facility (FFTF). Current plans call for the EBR-II, which has been operating for a number of years, to be directed to other testing programs sometime after the startup of FFTF, presently scheduled for late 1979. However, since there may be a period of time during which both facilities are operating and available for specimen irradiation, features and characteristics of both will be discussed herein, although the emphasis will be on the FFTF. The purpose of this report is to provide the necessary background for considering possible collaborative programs on fracture toughness and crack growth of irradiated materials between USDOE and UKAEA, to be conducted under appropriate exchange agreements.

54697 (GA-A—15444) **GCFR upflow core design.** Lee, G.E. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 23p. (CONF-790572—4). Dep. NTIS, PC A02/MF A01.

From Helium Breeder Associates/US Dept of Energy GCFR technical meeting; San Diego, CA, USA (30 May 1979).

The gas-cooled fast breeder reactor (GCFR) core is composed of fuel, blanket, control, shutdown, and radial reflector/shield assemblies. This report presents a comparison of the designs of the core assemblies for a three-loop 300-MW(e) GCFR having an upflow core with those for a downflow core plant. The overall core arrangements, as well as the differences in core distortion behavior and core seismic response, are discussed.

54698 (GA-A—15462) **Improvements in residual heat removal reliability in the GCFR demonstration plant.** Torri, A.; Taniguchi, T.; Raabe, P.H. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-03-0167-023. 21p. (CONF-790572—8; CONF-790384—3). Dep. NTIS, PC A02/MF A01.

From Helium Breeder Associates/US Dept of Energy GCFR technical meeting; San Diego, CA, USA (30 May 1979).

Reliability of decay heat removal is an important safety consideration in the gas-cooled fast breeder reactor (GCFR). The design evolution of the residual heat removal (RHR) systems over the past few years has been markedly aided by system reliability analyses to the point where there is confidence that loss of coolable core geometry can be classified as a beyond-design-basis accident. This evolution proceeded in three steps. First, the reliability-limiting features in the total combination of RHR systems were investigated and the need for improvements in the reliability of the main loop cooling system for RHR as well as in the physical separation of RHR support systems between the main loops and the core auxiliary cooling systems (CACS) was established. Secondly, a wide range of RHR options for the main loop cooling systems were investigated resulting in the adoption of a new reference concept for the main loop RHR system. The third and last step then consisted of an evaluation of the reliability aspects of natural circulation decay heat removal in an upflow GCFR design. The major conclusion from this study is that decay heat removal can be reliable in the GCFR. Furthermore, the current limitations of natural circulation RHR reliability have been identified, and means to optimally exploit natural circulation have been defined.

54699 (GA-A—15511) **Overview of the GCFR core engineering development program.** Snyder, H.J. Jr. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 23p. (CONF-790572—7). Dep. NTIS, PC A02/MF A01.

From Helium Breeder Associates/US Dept of Energy GCFR technical meeting; San Diego, CA, USA (30 May 1979).

The gas-cooled fast breeder reactor (GCFR) core development plan has been described as an incremental extension of the LMFBR program. The basis for this contention is reviewed along with some additional gas-cooled reactor precedence. Ideally, in the development of a reactor concept, it would be desirable to demonstrate the perforance of a full-sized fuel assembly under the anticipated irradiation and coolant conditions. Practically, however, this is seldom possible, particularly in fast reactors where fluence-to-burnup ratios increase with reactor power. Because of this limitation, the GCFR development program is based on qualifying the assemblies for the low distortions that occur during the swelling incubation period (~ 50 MWd/kg). Extended burnup will be demonstrated in the operation of the GCFR demonstration plant core. The overall core development program and the related assumptions are discussed and the design goals stated. A multistage development approach is described and illustratd with an abbreviated program network. Major areas of the development program are briefly described.

54700 (GA-A—15514) **Steam ingress reactivity effects in the GCFR.** Hess, A.L.; Hamilton, C.J. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 29p. Dep. NTIS, PC A03/MF A01.

Because of the higher pressure on the steam side of the steam generator in the gas-cooled fast breeder reactor (GCFR), the potential exists for steam-generator tube leaks or ruptures which might introduce water vapor into the primary coolant and thence into the core region. This potential for core steam ingress requires that a satisfactory understanding of the reactivity effects due to various concentrations of hydrogeneous material in the core be achieved. The reactivity effects resulting from an increase in hydrogen density are two-fold: a decrease in neutron leakage from the core, and a moderation of the neutron energy spectrum. The leakage effect is always positive and is predominant in smaller systems with attendant higher leakage fractions. Also, the cold-to-hot operating core temperature transition produces a negative reactivity effect (to a large extent due to the Doppler effect on absorption in U-238), which is substantially increased by progressive softening of the spectrum due to hydrogen addition. Research programs studying these reactivity effects are described.

54701 (GA-A—15515) **PCRV design and pressure limits for GCFR.** Chow, G.S.; Koopman, D.C.A. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 18p. (CONF-790572—6). Dep. NTIS, PC A02/MF A01.

From Helium Breeder Associates/US Dept of Energy GCFR technical meeting; San Diego, CA, USA (30 May 1979).

This paper presents a review of PCRV design with special emphasis on pressure limitations for large GCFRs. Discussion on major factors affecting PCRV design includes tendon layout requirements; location and arrangement of major components, especially the steam generators, auxiliary heat exchangers, and main and auxiliary circulators; and the balance-of-plant interface requirements. Joint PCRV and containment design efforts are required to evaluate the impact of the horizontal circulator cavity on the PCRV design pressure limitation. Without major departure from current design

practice and the benefi. of detailed assessment of limiting factors, operating pressures up to 120 bars are found technically feasible.

54702 (GA-A—15518) **Life-limiting aspects of GCFR core assembly designs.** LaBar, M.P. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 20p. Dep. NTIS, PC A02/MF A01.

A review is made of the various potential life-limiting effects of current consideration in the GCFR core assemblies. The most life-limiting aspects are not related to individual fuel rod behavior characteristics, but rather to distortions within the rod bundles. Fuel rod internal fission gas is not limiting, as it is in most fast reactors, because of the GCFR pressure-equalization system. The life-limiting bundle distortions are the result of neutron-flux-enhanced creep and fast-fluence-induced metal swelling. These effects are somewhat unique to fast reactors and are material dependent. The current evaluations apply to the use of 20% cold-worked type 316 stainless steel as the core structural material. Alternate structural materials having lower neutron-fluence-induced metal swelling would reduce the distortions, in which case, the most life-limiting effect would likely be one of the more traditional effects such as fuel-clad mechanical interaction (FCMI).

54703 (GEFR—00067-3) **Program for the development of design data LMFBR steam generator materials.** (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jun 1979. Contract EY-76-C-03-0893-030. 140p. AT.

Progress in steam generator materials development and qualification for LMFBRs and the Clinch River Breeder Reactor is reported.

54704 (GEFR—00423) **Core restraint system design guidelines.** Fox, J.N. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jan 1979. Contract EY-76-C-03-0893-031. 64p. AT.

Guidelines contained herein were developed by examining the fundamental core restraint functional criteria which require that the core restraint system: (1) establish and control the radial and azimuthal position of the reactor core assemblies such that reactivity variations from radial and azimuthal motion will not limit safe reactor operation under all credible conditions; (2) maintain critical alignments between in-core and above-core components; and (3) permit refueling within specified load limits. While these functional criteria are important, they do not provide sufficient guidance to the individual designer (contractor) to develop detailed design criteria that are generally acceptable to the LMFBR community. This is due primarily to the complex behavior of the core restraint system, its many interfacing systems, and the individual interpretation of safe reactor operation. Hence a set of comprehensive core restraint system design guidelines are necessary that not only address the functional criteria, but reflect design and safety philosophies that are consistent with current core restraint engineering technology. These design guidelines, once endorsed by the CM & CP working group will allow each core restraint system designer to develop consistent and well-based detailed design criteria.

54705 (GEFR—13771-31) **Critical experiments and analysis. Thirty-first quarterly report, April-June 1979.** (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jul 1979. Contract EY-76-C-03-0893-031. 43p. Dep. NTIS, PC A02/MF A01.

Current activities and technical progress for the period April through June 1979 are reported herein. This report covers the technical direction for critical experiments and analysis as applicable to LMFBR commercial plants and the Clinch River Breeder Reactor Plant.

54706 (GEFR—14074-13) **Cooperative nuclear data and methods development. Thirteenth quarterly report, April-June, 1979.** Protsik, R. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jul 1979. Contract EY-76-C-03-0893-031. 21p. AT.

The objective of the Cooperative Nuclear Data and Methods Program is the development and working implementation of nuclear data and methods relevant to the design and analysis of fast breeder reactors. The specific objectives of the four individual subtasks are summarized as follows: Cooperative Nuclear Data Development - To participate in the activities of the Cross Section Evaluation Working Group (CSEWG) to evaluate the nuclear data which is relevant to the design of fast breeder reactors. Cooperative Methods Development - To participate in the development of nuclear design methods including code validation in the functional areas of data processing, the analysis of critical experiments, and the design of large power reactors. Actinide Recycle Analysis - To evaluate actinide recycle in LMFBRs and the eventual use of Pu-burners as a waste management option. Full Scale LMFBR Analysis - To evaluate methods and quantify approximations for use in the analysis of heterogeneous cores.

54707 (GEFR-SP—140) **Prediction of coolant mixing and peripheral flow in wire wrapped rod bundles.** Wei, J.P. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 1979. Contract EY-76-C-03-0893. 9p. (CONF-791103—14). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Thermal-hydraulic behavior in LMFBR wire-wrapped rod bundles was studied using the FULMIX-II code and the results compared with experimental data from the French 19-pin water flow tests.

54708 (HEDL-TME—79-24) **Sodium technology progress report, January—March 1979.** Atwood, J.M. (comp.). (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1979. Contract EY-76-C-14-2170. 54p. AT.

This report presents a quarterly summary of progress made at Westinghouse Hanford Company in the areas of radioactivity control technology and sodium systems technology.

54709 (INIS-mf—4506, pp vp) **Elastic and elastic-plastic buckling of vessel heads computation by the CEASEMT system.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In Liquid Metal Fast Breeder Reactors of integrated type, the sodium pressure is low, but the dimensions are large. The thickness-diameter ratios are rather smaller than in other type of nuclear pressure vessels. Therefore buckling must be considered as a potential mode of failure. For instance, the bottom head of the main vessel is loaded by internal hydrostatic pressure and dead weights, and there is a need for buckling analysis. It must be pointed out that in practical cases buckling occurs after plastic deformation. Due to the effect of initial imperfections elastic buckling is rather difficult to analyse. Morever, elastic-plastic buckling theory is not a very clear theory and consideration must be given to finite deflexions (and perhaps to initial stresses). So the choice of a suitable mathematical model is a matter of good engineering judgment. In the CEASEMT system of structural analysis by finite element method, a special program has been developed for that purpose. The model chosen (MOTAN) is near a tangent modulus model, because it seems a better approximation of the real behavior of mechanical structures. The buckling load of shells of any shape can be predicted. The method is now operational but a validation program is still in progress. Validation is especially based on buckling of vessel heads under internal pressure. Available results are given for ellipsoidal or torispherical heads. When it is possible comparison is made with known experiment.

54710 (INIS-mf—4506, pp vp) **Thermal elasto-plastic analysis in reactor vessel nozzles.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In a sodium cooled nuclear fast reactor the thermal analysis has a particular importance as a consequence of the rapid transients and the high sodium conductivity. The aim of this work is to estimate the value of transient thermal stresses in elastic and plastic fields. In the first part, the loading conditions for different steady and transient operations are examined. A number of tests was planned to simulate in a mock-up the temperature changes in the upper part of the vessel for different thermal transients considered most dangerous: scram to full power, electric supply fault in a pump with reactor scram, pump seizure with reactor scram. A mock-up in scale 1 : 4 simulating the vessel area above the core was built-up. The heat transfer is simulated with a mass transfer; with this simulation it is not considered that the heat conduction in the sodium and the thermal gradients measured are higher than in the reactor. The temperature transients have been obtained with a different salt concentration: the water simulates the hot sodium and the water salted represents the cold sodium. In the second part of the work is considered the thermo-elastic structural response using the FEM analysis. The elastic approach has had two functions: the first is to find a simplified structure in two dimensions that has the same behavior as the 3-D nozzle; the second is to follow the thermal transient to look for the time of maximum stress. For different geometry, in a previous paper, the stress distribution and the influence of some characteristic parameters have been examined. As a result of this part an axisymmetric geometry has been chosen and also the time of maxim.

54711 (INIS-mf—4506, pp vp) **Influence of sodium temperature, gamma heating and wall thickness on design strength of SLSF containment vessels.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54712 (INIS-mf—4506, pp vp) **Thermal ratchetting in pressure vessels.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

During its lifetime a nuclear power plant undergoes cyclic thermal loadings, i.e. time variations of temperature spatial distribu-

tion; these thermal cycles, combined with mechanical loads (pressure), can produce dimensional changes for creep, plastic cycling and/or ratchetting. This problem is in special way important for a Liquid Metal Fast Breeder Reactor (LMFBR) because temperatures in it are high (about 500°C) and change either in radial direction or in axial direction. While the plastic behavior of a structure subjected to mechanical loads and/or mechanical cyclic loads can be well studied with the by Finite Element analyses and several different computer programs, the thermal plastic behavior was studied for simplified conditions only. Actually, the Bree, Miller, Burgreen model considers a thin cylindrical shell with a radial thermal gradient and in uniaxial stress state while Kalnins, Updike extend this model to a biaxial stress state. To obtain numerical results of the thermo-plastic behavior of cylindrical shells, a mathematical model was developed and the special purpose computer program PLAST was implemented.

54713 (INIS-mf—4541, pp vp) **Simple steel/water model for preliminary studies of acoustic vibration in LMFBR.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

One source of vibration excitation in Liquid Metal Fast Breeder Reactors is the acoustic energy which is generated by the circulating pump and transmitted through the fluid to various structural components. Since most of the energy occurs at fairly low frequencies, that of low harmonies of blade passing frequency, only the very large components have resonant frequencies such that they are significantly excited. To gain some preliminary understanding of the extent and magnitude of vibration in fast reactors therefore, a simple model has been constructed in which only the major components are represented. The modelling theory is discussed and it is shown that adequate representation of the steel/sodium reactor materials can be obtained in the model based on the use of steel/water. The model represents a pool design with a primary tank of 3 1/4 metres diameter and typical components scaled in proportion; however, it does not necessarily relate to any specific reactor design. The pump acoustic source is represented by an underwater loudspeaker system and vibration amplitudes are scaled according to typical pressures generated by reactor circulators. Results from the model include calibration data for the acoustic source and measurements of acoustic pressure throughout the primary flow circuit and the inner and outer pools. Stresses are measured on structural components over a frequency range scaled from reactor frequencies and compensated for the characteristics of the acoustic source. Appreciable stresses are found on all the components in the primary circuit, not necessarily only those close to the simulated pump source. After scaling them to reactor size and allowing for the source calibration, it is found that stresses are unlikely to be sufficiently high to cause damage.

54714 (INIS-mf—4541, pp vp) **Fracture of longitudinally cracked ductile tubes.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54715 (INIS-mf—4541, pp vp) **Temperature and stress responses of clean evaporator tubes under oscillatory water rivulet action in DNB region.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54716 (INIS-mf—4541, pp vp) **Vibrational analysis of the SUPERPHENIX internal shells.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54717 (INIS-mf—4541, pp vp) **Computerized thermal input for steam generator stress analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In order to perform structural analyses of the CRBRP steam generators (hydraulic transients) detailed thermal profiles must be developed and transmitted to the stress analyst in a usable form. A unique, semi-automated computer system has been developed to optimally accomplish this task. The transient data are given in the specification in the form of sodium and water (steam) flow, temperature and pressure at the inlet of the steam generator as a function of time. The steam generator is divided into fourteen distinct zones each consisting of several subzones. Masses of thermal data must be generated to provide temperature distributions in each subzone as a function of time. A simplified nodal model of the entire steam generator is used to translate the specification transient data into boundary conditions for the detailed subzone models. This is accomplished by the SETS (Superheater-Evaporator Transient Simulation) program. A one-to-one correlation between the stress and thermal models has been set up to enhance accuracy and simplify data transmittal. The stress analyst develops a finite element model to the degree of detail required by the MARC computer code. Nodes are added to this model and the thermal model development is accomplished using STAMP (Stress to Thermal Adaption Model Program). Thermal analysis is accomplished using a finite difference code - TAP (Thermal Analyzer Program). The SETS tape is used to provide the boundary conditions. Significant temperatures and temperature differences are output, isotherms are also output TEMPOS (Temperature Postprocessor) is then used to extract the thermal data and present the results in such a manner that the maximum stress intensity range may be calculated.

54718 (INIS-mf—4541, pp vp) **Flow-induced vibration bench testing of reactor components.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54719 (INIS-mf—4541, pp vp) **Effect of tube-support interaction on the dynamic response of heat exchanger tubes.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

As a part of ANL's Flow-Induced Vibration Program in support of the Clinch River Breeder Reactor Plant (CRBRP) steam generator design activity, tube/support interaction experiments are being performed not only to gain the insight into the dynamic behavior of CRBRP steam generator tubes, but also to provide the basis for developing design guidance. In the experiment, the tube and supports are prototypic, the tube spans nearly prototypic, and overall length approximately one-third that of a straight tube segment of the CRBRP steam generator. The test model features a 15.88 mm dia.x3.18 mm thick x 5.08 m long tube (2-1/4% Cr - 1% Mo) surrounded by water, a 101.60 mm thick tubesheet, seven 25.44 mm thick stainless steel supports with 0.254 mm tube-to-support hole clearances and two closely-spaced supports adjacent to the excitation span. The tube is excited by electromagnetic coils simulating crossflow excitation; two displacement transducers, orthogonal to one another, are positioned at the center of each span. Tube response of the midspan locations were measured as a function of various input excitation levels and frequencies. Test results were compared with analytical results based on multispan tube with 'knife-edge' supports at the support locations. Test results show that the resonant frequencies are close to those of the analytical results; experimental modes are in good agreement with analytical predictions or the tube/support configuration tested, peak displacement amplitudes are always lower than those of analytical results; closely-spaced double supports do not effectively dampen out the vibration responses of the adjacent spans and significant orbital motions exist in the spans away from the excitation. It is concluded that a mathematical model assuming a multi-span beam fixed at the tubesheet with intermediate 'knife-edge' supports satisfactorily predicts natural frequencies and mode shapes for the tube/support configuration studied.

54720 (INIS-mf—4543, pp vp) **Thin circular cylinder under axisymmetrical thermal and mechanical loading.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

To assess structural integrity of components subjected to cyclic thermal loadings one must look at thermal ratchetting as a possible failure mode. Considering a thin circular cylinder subjected to constant internal pressure and cyclically varying thermal gradient through the thickness Bree, J. Strain Analysis 2 (1967) No.3, obtained a diagram that serves as a foundation for many design rules (e.g.: ASME code). The upper part of the french LMFBR main vessel is subjected to an axisymmetrical axial thermal loading and an axial load (own weight). Operation of the reactor leads to cyclic variations of the axial thermal loading. The question that arises is whether or not the Bree diagram is realistic for such loading conditions. A special purpose computer code (Ratch) was developed to analyse a thin circular cylinder subjected to axisymmetrical mechanical and thermal loadings. The Mendelson's approach of this problem is followed. Classical Kirchoff-Love hypothesis of thin shells is used and a state of plane stress is assumed. Space integrations are performed by Gaussian quadrature in the axial direction and by Simpson's one third rule throughout the thickness. Thermoelastic-plastic constitutive equations are solved with an implicit scheme (Nguyen). Thermovisco-plastic constitutive equations are solved with an explicit time integration scheme (Treanor's algorithm especially fitted). A Bree type diagram is obtained for an axial step of temperature which varies cyclically and a sustained constant axial load. The material behavior is assumed perfectly plastic and creep effect is not considered. Results show that the domain where no ratchetting occurs is reduced when compared with the domain predicted by the Bree diagram.

54721 (INIS-mf—4543, pp vp) **Plastic creep behavior analysis of an elbow pipe.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

High temperature components are liable to strong creep effects, in LMFBR for example. This phenomenon is analyzed here for an elbow pipe. Comparisons are performed between experiments and computations using CEASEMT codes, particularly piping-system

analysis code TEDEL. The reference is an experiment from Batelle's Columbus Laboratories and concerns a 4 in-sh 10 elbow pipe assembly made of type 304 stainless steel at room temperature and then at 593°C (1100°F) during more than 300 hours. The assembly is loaded by inplane moment; displacements, temperatures and strain measurements are picked up. Computations are first performed using the finite element codes developed by CEA. For creep analysis iterative processes referring to the normality principle of HILL are used: during steps of iterations, equilibrium and yield criterion are always met.

54722 (INIS-mf—4543, pp vp) **Creep-fatigue design criteria for application to a 2 1/4 Cr.-1 Mo LMFBR steam generator.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A study was undertaken to evaluate alternate criteria for creep fatigue evaluation of LMFBR steam generators constructed of 2 1/4 Cr.-1 Mo alloy steel. A review was conducted of the ASME Criteria for Design of Elevated Temperature Class 1 Components and the existing data available for 2 1/4 Cr.-1 Mo alloy steel. The current method in the Code for calculating creep-fatigue interaction damage using linear summation of fatigue damage and creep damage was employed on the existing test data. Alternately, the strain range partitioning method was considered. It was determined that the Code method is generally conservative for predicting life of the 2 1/4 Cr.-1 Mo test specimens, and the strain range partitioning method, as originally proposed, appeared to be unconservative when extrapolated to the low strain range long hold time service required by the design. A series of creep relaxation analyses employing the linear time fraction creep damage rule to evaluate the effect of plant thermal transients on the predicted design life and sensitivity of calculated creep damage to various material behavior parameters was conducted. Several creep equations and the effect of biaxiality were studied to determine their effect on stress relaxation and calculated creep damage. Calculated stress relaxation results from various creep equations were compared to measured relaxation from structural tests to aid in selecting an appropriate creep equation. In order to explore the sensitivity of calculated creep-fatigue damage to primary stress intensity, an infinite thick-cylinder was analyzed for variable pressure conditions using elastic-plastic-creep finite element techniques. In order to evaluate the effect of potential elastic follow-up effects on calculated creep damage, a built-in cylinder was also analyzed by finite element techniques.

54723 (INIS-mf—4543, pp vp) **Behavior of annealed type 316 stainless steel under monotonic and cyclic biaxial loading at room temperature.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54724 (INIS-mf—4543, pp vp) **Instability analysis of elbows in the plastic range.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This work presents some basic considerations underlying the instability in the plastic range of typical LMFBR elbows (radius-to-thickness ratio $r/t = 20\text{-}50$), and the impact of these considerations on the practical aspects of solution by computer methods. The elbows are made from a strain hardening material and they are loaded by in-plane closing or opening bending moments. A simplified method of computer analysis is used and the particular type of instability considered is that of geometric buckling into a mode that is characterized by significant ovalization of the cross section and by a relatively gradual variation in shape along the length of the elbow. Emphasis is placed on the effects of including geometric nonlinearities (large displacement terms) in the inelastic (time-independent) analysis. Numerical results are presented for a typical LMFBR elbow. A general discussion of the basic concepts and definition of the instability of structures made from strain hardening or from elastic materials is given. Such a discussion is needed to facilitate a complete understanding of the present numerical results and to avoid possible misinterpretations in a comparison of these and previous results. The major conclusions of this investigation are as follows: (1) Geometric nonlinear effects are significant, (2) The inclusion of such effects in an analysis of an elbow subjected to either a closing or an opening moment reveals that the buckling load is lower for the case of a closing moment. The buckling load for this case corresponds to a maximum point (zero slope) in a typical load-displacement curve, and (3) the omission of geometric nonlinear effects in the inelastic analysis leads to a load-displacement curve in which the load monotonically increases with displacement.

54725 (INIS-mf—4543, pp vp) **Creep buckling of shells.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Because of the characteristics of LMFBR primary piping components (thin-walled, low pressure, high temperature), the designer must guard against creep buckling as a potential failure mode for certain critical regions, such as elbows, where structural flexibility and inelastic response may combine to concentrate deformation and cause instability. The ASME Boiler and Pressure Vessel Code, through its elevated temperature Code Case 1592 (Section III, Division 1) provides design rules for Class 1 components aimed at preventing creep buckling during the design life. A similar set of rules is being developed for Class 2 and 3 components at this time. One of the original concepts behind the creep buckling rules was that the variability in creep properties (especially due to the effects of prior heat treatment), the uncertainty about initial imperfections, and the lack of confirmed accuracy of design analysis meant that conservatism would be difficult to assure. As a result, a factor of ten on service life was required (i.e. analysis must show that, under service conditions that extrapolate the life of the component by ten times, creep buckling does not occur). Two obvious problems with this approach are that: first, the creep behavior must also be extrapolated (since most creep experiments are terminated at a small fraction of the design life, extrapolation of creep data is already an issue, irrespective of the creep buckling question); second the nonlinear creep analysis, which is very nearly prohibitively expensive for design life histograms, becomes even more costly. Analytical results for an aluminum cylindrical shell subjected to axial loads at elevated temperatures are used to examine the supposed equivalence of two types of time-dependent buckling safety factors - a factor of ten on service life and a factor of 1.5 on loading.

54726 (INIS-mf—4543, pp vp) **Analysis of piping systems for creep.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this paper is to provide a survey of the current situation and to attempt to explain and clarify a number of misconceptions which have arisen in connection with approximative techniques. Recently there have become available several Finite Element computer codes for the analysis of vessel type structures which can deal with any geometry, loading condition and material behavior. However, a finite element analysis of a large diameter complex piping system for high temperature reactor service is simply not feasible economically to the detail and accuracy of a pressure vessel analysis; in any case, the aim is to produce a flexible system. Even those simplified finite element methods which have been designed to cope principally with piping are not practical for the initial stages of design for elevated temperature. Ideally, a simple flexibility beam approach, similar to those classically used in elastic analysis, would be desirous. Such an approach has so far only been achieved using simplifications to the creep response. The two simplified methods which are primarily used are known generally as Kachanov's Method and the Method of Superposition of States. In this paper the reliability of these approximations is examined for simple piping components under combined loading; these also serve to clarify a number of misconceptions which have arisen over the methods. It is then discussed not only how these simplified methods can be adapted to the analysis of piping systems but also how a more general beam type approach could be constructed, and what sort of information would be necessary for their successful implementation.

54727 (INIS-mf—4543, pp vp) **Evaluation of inelastic analysis methods.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this presentation is to explore this question relative to interim inelastic analysis guidelines that have been recommended for use in the design of liquid-metal-cooled reactor system components. Interim constitutive equations have been developed for describing the inelastic behaviors of types 304 and 316 stainless steel and 2 1/4 Cr-1 Mo steel. Although differing in detail, the recommended constitutive equations for these three materials are basically of the same form. They rest on the fundamental assumption that an increment of total strain consists of four additive contributions: thermal, elastic, plastic, and creep. The specification of the plastic and creep strains follows from the concepts of classical kinematic hardening plasticity theory and strain-hardening creep theory. These concepts are augmented, however, with ad hoc rules to account for such things as cyclic hardening and/or softening, aging, and the effects of prior inelastic straining on subsequent plastic and creep deformations. Uniaxial and multiaxial exploratory tests were used to identify the essential inelastic behavioral features of significance, and these features, in turn, provided the basis for choosing the interim constitutive equations. Typical exploratory test results are presented to support the basic constitutive equation framework and to illustrate how the ad hoc rules were developed, evaluated, and improved. To assess the validity of the constitutive equations and analysis methods for high-temperature design, benchmark structural tests were conducted under time-varying loadings at elevated temperatures, and the results were compared to inelastic analysis predictions. Representative test results for beam and plate structures and for a pipe subjected to repeated thermal shocks are presented and compared to predictions.

54728 (INIS-mf—4543, pp vp) **Finite element elastic-plastic analysis of LMFBR components.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54729 (INIS-mf—4543, pp vp) **Fatigue damage analysis procedure for thermal liners subjected to random thermal fluctuations.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Of particular concern in this paper is the structural analysis of thermal shock liners in liquid sodium systems subjected to sinusoidal and random thermal fluctuations produced by mixing of hot and cold fluid streams. The development of the response function, relating thermally induced surface stresses to both low and high frequency sinusoidal surface temperature fluctuations, enables one to develop a method of determining fatigue damage of the structural components by conventional random vibration analysis techniques. Having the response function for the thermal shock liners enables one to predict the fatigue damage due to thermal fluctuation having either wide-band or narrow-band spectral characteristics. Although results are presented for a particular analysis - the analytical procedures can be easily adapted to consider other thermal environments.

54730 (INIS-mf—4592) **Dynamic response of single hexagonal LMFBR core subassembly wrappers.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.E)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

To analyze the dynamic structural response of the LMFBR core subassembly hexagonal wrappers to postulated local energy releases and the sensitivity of the response to variations in both the pressure loading and the material properties of the stainless steel, a finite-element computer code STRAW has been developed. A series of experiments was performed to study the effects of variations in material properties. The amount of coldworking to which the Type 316 stainless steel is subjected has a strong influence upon the ductility and the elastic yield point. The usual fabrication process produced a nominally 20% coldworking with a yield point of about 680 MPa. By designing a special set of dies for the drawing process, a very low ductility hexcan was produced for which the yield point was raised to 820 MPa. Conversely, the yield point was lowered to 170 MPa by a solution annealing process producing a highly ductile test hexcan. A metallurgical study was conducted to find a representative brittle simulant material for the irradiated end-of-life steel properties. An aging treatment for Type 446 stainless steel was developed which reproduced the expected tensile-flow behavior of the in-pile subassembly. Further study is underway to investigate the fracture properties of the simulant material. The pressure pulses were generated by the controlled expansion of high-pressure detonation poducts from low-density explosives detonated inside a vented steel cannister. The orifice configuration of the cannister and the charge mixture ratio were designed to produce two specified pulse shapes. A charge containing 37.7 g PETN mixed with 35 wt % inert, hollow-glass microballoons developed a pressure pulse peak of 9.5 MPa at 1.0 ms. Increasing the PETN to 41 g resulted in a 14.6 MPa peak pressure, and increasing the explosive concentration to 90 wt % in the mixture increased the burning rate and the pulse risetime, so that the peak occurred at 0.6 ms.

54731 (INIS-mf—4592) **Dynamic loadings of sodium-water reactions in LMFBR and fusion power designs.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.E)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In liquid metal fast breeder reactor and lithium cooled fusion reactor, a sodium loop is being proposed to transfer heat from the primary coolant loop to the steam turbine cycle. Although by careful design and quality assurance programs, the probability for steam generator tube failure can be minimized, failure will still occur. The direct contact of sodium and water would cause a chemical reaction where hydrogen and sodium compounds are produced. This paper presents an evaluation of the potential hazards as a result of such a reaction. An analytical method is developed to investigate the extent of the reaction zone and the propagation of the pressure wave in the sodium system. In the calculation, the chemical reaction is assumed to be instantaneous, governed by the equation $2Na(l)+H_2O(l)\rightarrow Na_2O(l)+H_2(g)+31.4$ K cal/gm. mole. Both the temperature and pressure rise in the reaction zone can be established from the energy balance and the equation of state for the gaseous product. As a consequence of the energy released, the chemical products suddenly expand with a high velocity. The expansion also generates a shock wave in both the water and the sodium systems. Results indicate that the reaction zone can expand in a rate of 1500 ft/sec and a shock wave with initial strength of 2300 atmospheres propagates with a speed of 8000 ft/sec into the sodium system. The propagating characteristics of the shock wave are obtained by solving the basic fluid equations. The shock wave decays rapidly, in the neighborhood of milliseconds, as soon as the reaction zone stops to expand. The decrease in the reaction zone pressure allows more water to react with the sodium and a second pulse is generated.

54732 (INIS-mf—4592, pp vp) **Effect of high external thermal loading on LMFBR subassembly integrity.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54733 (INIS-mf—4592, pp vp) **Analysis of EBR-II steam-generator system for pressure pulses due to leaks of steam or water into sodium.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54734 (INIS-mf—4592, pp vp) **Analyses of hydrodynamic effects of large sodium-water reactions.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Large leak sodium-water reactions that would occur in a steam generator of LMFBR causes abrupt changes of pressure and velocity of fluid in a secondary sodium system and relief system. This paper describes SOWACS-III together with its model and method. Results of analyses are also given, the comparison with experimental results of initial pressure spike being included. SOWACS-III treats the system which consists of the steam generator, vessel, valve, pump and pipe, and uses the following models and methods. (1) Components are assumed to be one-dimensional. (2) Pressure wave propagation near a reaction zone, where hydrogen is generated, is analyzed with the spherical co-ordinate (sphere-cylinder model). (3) A moving boundary is formed by contact of sodium with other fluid such as hydrogen and nitrogen. The boundary travels without mixing of sodium and another fluid through the boundary (boundary tracking model). The boundary can be treated not to move from the original place (fixed boundary model). (4) Pressure wave propagation is analyzed by the explicit method of characteristics in one-dimensional Eulerian co-ordinate. (5) Flow-induced force is analyzed by momentum balance. (6) The lateral motion of relief piping caused by the force is analyzed by NAS-TRAN code. Analyses were carried out for large sodium-water reaction experiments in SWAT-3 rig of PNC by using the sphere-cylinder model. The calculated pressure spike in the reaction vessel was compared with the measured one for a few milliseconds after water injection. The calculated value and measured one were 6.4 ata and 6.7 ata for peak pressure and 0.6 ms and 2.8 ms for rising time, respectively.

54735 (INIS-mf—4638, pp vp) **Pressure transient analysis in single and two-phase water by finite difference methods.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

An important consideration in the design of LMFBR steam generators is the possibility of leakage from a steam generator water tube. The ensuing sodium/water reaction will be largely controlled by the amount of water available at the leak site, thus analysis methods treating this event must have the capability of accurately modeling pressure transients through all states of water occurring in a steam generator, whether single or two-phase. The equation systems of the present model consist of the conservation equations together with an equation of state for one-dimensional homogeneous flow. These equations are then solved using finite difference techniques with phase considerations and non-equilibrium effects being treated through the equation of state. The basis for water property computation is Keenan's 'fundamental equation of state' which is applicable to single-phase water at pressures less than 1000 bars and temperatures less than 1300°C. This provides formulations allowing computation of any water property to any desired precision. Two-phase properties are constructed from values on the saturation line. The use of formulations permits the direct calculation of any thermodynamic property (or property derivative) to great precision while requiring very little computer storage, but does involve considerable computation time. For this reason an optional calculation scheme based on the method of 'transfinite interpolation' is included to give rapid computation in selected regions with decreased precision. The conservation equations were solved using the second order Lax-Wendroff scheme which includes wall friction, allows the formation of shocks and locally supersonic flow. Computational boundary conditions were found from a method-of-characteristics solution at the reservoir and receiver ends. The local characteristics were used to interpolate data from inside the pipe to the boundary.

54736 (INIS-mf—4638, pp vp) **Damping of the radial impulsive motion of LMFBR core components separated by fluid squeeze films.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The core deformation of a liquid metal cooled fast breeder reactor (LMFBR) due to local pressure propagation from rapid energy releases is a complex three-dimensional fluid-structure-inter-

action problem. High pressure transients of short duration cause structural deformation of the closely spaced fuel elements, which are surrounded by the flowing coolant. Corresponding relative displacements give rise to a squeezing fluid motion in the thin layers between the subassemblies. Therefore significant backpressures are produced and the resulting time and space dependent fluid forces are acting on the structure as additional non-conservative external loads. Realistic LMFBR safety analyses of several clustered fuel elements have to account for such flow induced forces. This paper describes two fluid flow models (model A, model B), which are shown to be suitable for physically coupled fluid-structure analyses. Important assumptions are discussed in both cases and basic equations are derived for one- and two-dimensional incompressible flow fields. The interface of corresponding computer codes FLUF (model A) and FLOWAX (model B) with structural dynamics programs is outlined. Finally fluid-structure interaction problems relevant to LMFBR design are analyzed; parametric studies indicate a significant cushioning effect, energy dissipation and a strongly nonlinear as well as timedependent damping of the structural response.

54737 (INIS-mf—4638, pp vp) **PTA-1 computer program for treating pressure transients in hydraulic networks including the effect of pipe plasticity.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Pressure pulses resulting from a sodium-water reaction occurring in a steam generator in an LMFBR intermediate heat transport system may plastically deform the thin-walled piping typically used in such systems. This plastic deformation has a significant effect on pressure transient propagation, since it limits the peak pressure transmitted out of a pipe to approximately its yield pressure if the pipe is sufficiently long. The computer code PTA-I incorporates the effect of plastic deformation of the piping on pressure transient propagation in complex hydraulic networks. Although it was developed for predicting the propgation of pressure pulses in the intermediate heat transport system of an LMFBR, it may also be used to analyze transient propagation in other complicated piping networks for which fluid-hammer theory is appropriate. PTA-I uses the one-dimensional method-of-characteristics applied to fluid-hammer analysis of pressure transients in large piping systems. Non-linear convective terms, pipe friction and fluid compressibility are included in the formulation of the governing equations. The effect of plastic deformation of piping is incorporated through a modified fluid wave speed which varies with deformation history at each computational node in a plastically deforming pipe. An iterative procedure is employed to locate the characteristic curves, through the wave speed, are a function of fluid pressure and pipe deformation history. Various types of junctions and fittings may be specified; these include closed ends, multi-branched tees, surge tanks, sudden expansions and contractions, dummy junctions, acoustic-impedance discontinuities, non-reflecting far-end boundaries, and simple models for pumps and rupture disks.

54738 (INIS-mf—4691, pp 3-60) **Project fast breeder (PSB).** 1978. (In German).

In Progress report on research and development in 1977.

The annual report of the fast breeder project (PSB) contains contributions of the participating institutes on the four subjects: 1) Development of oxidic fuel rods and materials for the SNR line, 2) Physics and safety investigations for the SNR line, 3) Carbidic fuel elements, and 4) Back-up solution with gaseous coolant.

54739 (INIS-mf—4911) **Investigations of temperature fluctuations in liquid sodium in order to determine characteristic flow parameters and thermocouple transfer functions.** Benkert, J. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 1977. 104p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

Diss. (D.Eng.).

Because of narrow geometries and high thermal loads mainly thermocouples are used to monitor the coolant state in the reactor core, the heat exchangers and the piping. The aim of the present paper is to determine the transfer behavior of different types of thermocouples, the local influencing of the temperature fluctuations and to what extent the heat transfer coefficient fluid/wall may be evaluated from the measurements performed. The experiments to study these problems were carried out in three test beds for liquid sodium. The good agreement between model calculations and the experiments made allow the experimenter to make interpretations of extreme flow conditions on one hand and the owners of plants to select and apply optimally thermocouples under normal operating conditions on the other.

54740 **Photoelastic investigation of a reactor building.** Jullien, F.J.; Morel, A. pp 855-859 of 6. Internationale Konferenz 'Experimentelle Spannungsanalyse'. Duesseldorf, Germany, F.R.; VDI-Verl. (1978). (In French)

From 6. conference on experimental stress analysis; Munich, F.R. Germany (18 Sep 1978).

This paper is devoted to the study of the nuclear reactor containment sheltering the Super Phenix Surgenerator. This structure of civil engineering is very important because of its sizes and of its complexity. A model of this building and of the next soil has been fabricated with a reduced Scale of 1/200; the soil has been there considered as a boundary condition. The fabrication of a closely fitting model has required many studies on the materials, and on the technology adapted to the mouldering and the loading of this reduced structure. The results confirm the whole behavior as obtained by the calculation. In addition, they complete the study by giving the local behavior in singular areas; in this way, the allow the optimisation of the design.

54741 (SAN—0824-T1) **Sodium leak detection verification test results.** Witherspoon, J.E. (Rockwell International Corp., Canoga Park, CA (USA)). 27 Jul 1979. Contract EY-76-C-03-0824-012. 230p. AT.

Portions of document are illegible.

The results are presented for Sodium Leak Detection Verification Tests. In these tests, the required performance of selected CRBRP sodium-to-gas leak detection methods, which have application in LMFBR plants, was verified. Testing, in accordance with N707DRS520001, was performed by ETEC personnel. Copies of ETEC reports on the tests are included in Appendix A which comprises Volume 2 of this report.

54742 (SAN—0824-T2) **Sodium leak detection, long term performance test: results for FY 1978.** Witherspoon, J.E. (Rockwell International Corp., Canoga Park, CA (USA)). 20 Jun 1979. Contract EY-76-C-03-0824-012. 36p. AT.

The results are presented for the first 18 months of the long-term performance tests of aerosol-type sodium leak detectors. The equipment, which was designed and assembled at AI-ESG, is installed at EBR-II, and the operation is monitored by EBR-II personnel.

54743 (SAN—0824-T4) **Sodium leak detection long term performance test: results for first six months.** Witherspoon, J.E. (Rockwell International Corp., Canoga Park, CA (USA)). 5 Jun 1978. Contract EY-76-C-03-0824-012. 34p. AT.

The results are described for the first 6 months of the long-term performance tests of aerosol-type sodium leak detectors. The operation of the equipment, installed at EBR-II, is monitored by EBR-II personnel.

54744 (SAN—0824-T7) **Sodium leak detection verification test results.** Witherspoon, J.E. (Rockwell International Corp., Canoga Park, CA (USA)). 27 Jul 1979. Contract EY-76-C-03-0824-012. 54p. AT.

This report describes the results of Sodium Leak Detection Verification Tests. In these tests, the required performance of selected CRBRP sodium-to-gas leak detection methods, which have application in LMFBR plants, was verified. Testing, in accordance with N707DR520001, was performed by ETEC personnel. Copies of ETEC reports on the tests are included in Appendix A which comprises Volume 2 of this report.

54745 (WAPD-TM—1370) **Effect of simulated thermal shield motion on nuclear instrument response: measurements and calculations (LWBR Development Program).** Schick, W.C. Jr.; Emert, C.J.; Shure, K.; Natelson, M. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Aug 1979. Contract EY-76-C-11-0014. 22p. Dep. NTIS, PC A02/MF A01.

An experiment has been performed to determine the effect of motion of a thermal shield on the neutron signal expected from ex-core detectors. Using a mockup of the LWBR reactor vessel, thermal shield, and core barrel in conjunction with a ^{252}Cf neutron source, the change in detector signal with displacement of the various components was investigated. It was found that moving the thermal shield would produce a significant change in detector signal, although the effect was smaller than would be produced by moving the source and core barrel together. The results were substantiated by two-dimensional discrete-ordinate calculations.

54746 (WARD-SD—94000-2) **MATLIB: a computer library of material properties verification manual.** Konish, H.J.; Snow, A.L. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jul 1979. Contract EY-76-C-02-3045-042. 239p. AT.

The difficulties inherent to the analysis and evaluation of structural behavior in the elevated temperature regime may be significantly reduced by the use of the MATLIB library of computer programs and subroutines for characterizing material behavior at elevated temperatures. This library provides the analyst with a large selection of descriptions of material behavior in the elevated temperature regime and a variety of design limits with which predicted structural response may be compared to assess structural adequacy. These items are provided in a form that facilitates ready access and widespread general use. One of the principal virtues of MATLIB is that each item has been subjected to extensive verification prior to

release for general use. The term verification, as used herein, refers to the correct execution of specified calculational procedures. The verification of MATLIB items is described in this report.

54747 (ANL-Trans—1173) **Large scale primary sodium pumps.** Guidez, J.; Canavelis, R.; Guilloiseau, P. Translated from *Houille Blanche;* No. 7/8, 719-725(1977). 17p. Dep. NTIS, PC A02/MF A01.

A design study on primary sodium pumps for fast reactors is described. The study was performed for a 1200 MW(e) reactor with 4 pumps.

54748 (SAN—0824-T8) **Sodium leak detection.** Fletcher, F.; Gajewski, W.M. (Rockwell International Corp., Canoga Park, CA (USA)). [nd]. Contract EY-76-C-03-0824-012. 102p. AT.

Research and development in sodium leak detection is reviewed. Topics covered include leak detector types, applications and requirements, development test programs, and analytical efforts and systems sensitivities.

ECONOMICS

REFER ALSO TO CITATION(S) 55059

54749 (ORNL/TM—6860) **Guidelines for estimating nonfuel operation and maintenance costs for alternative nuclear power plants.** Myers, M.L. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 40p. Dep. NTIS, PC A03/MF A01.

Guidelines are presented for estimating annual nonfuel operation and maintenance (O & M) costs for alternative nuclear power plant concepts being evaluated by the Plans and Analysis Division, Office of Nuclear Energy Programs, US Department of Energy. Specific concepts are the high-temperature gas-cooled reactor (HTGR), pressurized heavy-water reactor (PHWR), gas-cooled fast breeder reactor (GCFR), and liquid-metal-cooled fast breeder reactor (LMFBR). An existing computer program, OMCOST, was adapted to include these plant options.

FUEL CYCLE

54750 (GA-A—15130) **High-temperature gas-cooled reactor near-breeder cycles.** Brogli, R.; Shirley, G. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract AT03-76ET35300. 63p. Dep. NTIS, PC A04/MF A01.

High-temperature gas-cooled reactor (HTGR) fuel cycles which minimize fuel consumption are evaluated. Conversion ratios of unity and slightly higher are possible, but from an economics and resource standpoint, HTGR fuel designs with conversion ratios of 0.9 to 0.95 are more promising owing to reduced fuel inventories and recycle losses.

54751 (ORNL/TM—5961) **Thorium fuel cycle studies: fuel fabrication process and cost estimation.** Olsen, A.R. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 66p. Dep. NTIS, PC A04/MF A01.

Early in 1976 a study was made to assess the relative economics and fuel utilization of thorium and uranium fuel cycles in various types of reactors. It was to be completed in approximately two months, so all component parts had to be developed in a short time with a high degree of dependence on existing information. One of the components required for the study was a consistent set of relatively accurate fuel fabrication costs for the various reactor-fuel combinations. A report documents the rationale used in generating these cost estimates and presents in some detail the basis and methodology employed. Since three types of thermal flux reactors (LWR, HWR, and HTGR) and two types of fast flux reactors (liquid metal and gas cooled) together with three fuel forms (oxides, carbides, and metal) were included in the study with various combinations of the fissionable metals U, Th, and Pu, it was necessary to define a methodology that would permit a rapid relative estimate for each case. Existing cost studies were chosen for a Light-Water Reactor with low-enriched uranium fuel and for a High-Temperature Gas-Cooled Reactor with highly enriched uranium and thorium fuel as the reference cases which could be compared with other reactor-fuel combinations.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 54032, 54033, 54266, 54681

54752 (LA—7592-MS) **Production of synthetic gas from nuclear energy sources.** Anderson, C.A.; Biery, J.C.; Booth, L.A. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract EW-78-Y-04-4183. 235p. Dep. NTIS, PC A11/MF A01.

This report documents a survey of nuclear energy sources and their potential application to the production of synthetic gas. The state-of-the-art in commercial nuclear fission reactors and ongoing R & D in advanced reactors is described. The status of fusion energy research and estimated timing of commercial availability are reported. Detailed surveys of high-temperature electrolysis and thermochemical cycles as means for producing synthetic gas from process heat are given. Synthetic gas production from radiolysis is discussed. A description of the nuclear fuel cycle and uranium reserve and resource estimates are presented. Separate abstracts were prepared for the eight background papers.

54753 (LA—7592-MS, pp 2.1-2.12) **Survey of fission energy sources for the production of synthetic gaseous fuels.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

Synthetic gaseous fuels can be produced with the aid of energy from nuclear fission sources in a variety of ways. Hydrogen can be produced from direct radiolytic dissociation of water in the cores of certain reactors, from electrolysis of water using electricity generated by nuclear plants, and from thermochemical cycles and coal gasification using the heat from high-temperature reactors. Synthetic methane can be produced from coal with the assistance of high-temperature reactors. The types of reactors that can be used for such fuel production and the viabilities of such production methods in terms of economics and time scales are surveyed and discussed.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

54754 (CEGB-RD/B/N—4388) **Commissioning of the jet-in-pool sodium experiment.** Morss, A.G. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1978. 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A sodium facility which has been built to examine the temperature distribution through a recirculating flow regime is described. This experiment, the so called 'jet-in-pool' experiments, forms part of a programme of work at BNL aimed at investigating thermal similarity between sodium and water. The objective of the programme is to establish the range of validity for using water models to simulate liquid sodium reactors. The facility is not yet fully operational due to some problems with the air-blast cooler, but the commissioning programme carried out to date has been very successful. The techniques used to ensure the accurate measurement of sodium temperature and flow are described. The design of the 90 kW heater in use on this facility is also discussed. Some initial experimental data is presented but due to the cooler problems the results are not yet suitable for comparing with water. However, it is concluded that the facility and the installed instrumentation are capable of obtaining the required experimental accuracy and that once the loop is fully operational the experimental objectives should be realised.

54755 (COO—2458-25) **General multigroup nodal procedure based on response matrix principles.** Menezes, A.DaC.; Becker, M. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering). 1979. Contract EY-76-S-02-2458. 6p. (CONF-791103—3(Summ)). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A general response matrix approach to nodal analysis has been extended to multigroup form. The assumptions associated with the procedure have been found to be acceptable in dealing with the situations encountered in fast reactors.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 55123, 55189, 55192, 55194, 55195, 55209, 55216, 55217, 55218, 55219, 55220, 55221, 55222, 55272, 55273, 55284, 55285, 55346, 55400, 55889

54756 (CONF-790802—43) **Creep ratcheting bounds from extended elastic core concept.** Porowski, J.S.; O'Donnell, W.J. (O'Donnell and Associates, Inc., Pittsburgh, PA (USA)). 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The concept of an elastic core near the middle of the wall at any location in a component subjected to cyclic loading in the presence of creep was introduced by the authors to obtain bounds on the creep ratcheting strains at that location. The concept was quite useful since only elastic and creep strains could occur in the elastic core. Detailed solutions were obtained for elastic-perfectly plastic cylinders subjected to internal pressure and cyclic thru-the-wall thermal stresses. The present work includes isotropic and/or kine-

matic hardening effects and arbitrary temperature dependence of the yield strength of the material. The application of the bounds is extended to include loading histories with severe cycles resulting in plastic ratcheting. In general the relaxation of thermal stresses may result in a net accumulation of strain. The commonly used solution for complete relaxation between cycles does not include enhanced creep effects, and the latter are significant in many design applications.

54757 (COO—2733-22) **Comparison of boundary element and finite element methods in two-dimensional inelastic analysis.** Morjaria, M.; Sarihan, V.; Mukherjee, S. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). May 1979. Contract EY-76-S-02-2733. 34p. Dep. NTIS, PC A03/MF A01.

The finite element method has been commonly used to solve boundary value problems in inelastic deformation of metallic structures. Recently, Mukherjee and his coworkers applied the boundary element method to such problems. Planar time-dependent inelasticity problems were considered and a constitutive model with state variables was used to describe material behavior. The accuracy and computational efficiency of these two methods are compared for certain selected planar problems. In order to make the comparison as meaningful as possible, in house computer codes developed by the same group at Cornell, are used.

54758 (COO—4122-27) **Mitigating effects in the plastic failure of shells subjected to axially dependent dynamic pressure loadings.** Horvay, G.; Veluswami, M.A. (Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering). Jul 1979. Contract EY-76-S-02-4122. 89p. Dep. NTIS, PC A05/MF A01.

This is essentially a revised version of Report GH-15, July 1978. The revision was necessitated by recognition of the fact that the Vaughan-Florence analysis (J. Applied Mechanics, 1970), while correctly stating the governing membrane deflection equation, used, for numerical convenience, a simplified version, omitting a hoop restoring force term. This approach led to excessive deformations. The present report incorporates the hoop restoring term which in GH-15, following in the footsteps of VF, was omitted. The results now come out much more favorably than before.

54759 (INIS-mf—4506, pp vp) **Stress analysis of pressure vessels and heat exchangers, using finite element techniques.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of the paper is to illustrate the finite element technique when applied to the elastic stress analysis of steel pressure vessels and heat exchangers. The method yields more realistic predictions for the stress distribution than the conventional methods do (as for example the ASME Boiler and Pressure Vessel Code). The problem which arises when applying the finite element technique to the stress analysis of reactor pressure vessels and heat exchangers is, that the inclusion of the individual tubes and perforations in the supporting tube sheets in the idealisation results in an extremely high computational effort. The way in which this problem is solved consists in performing the analysis in two steps. The first step is to analyse the entire reactor pressure vessel or heat exchanger by replacing the perforated plates by solid plates with the same stiffness behavior and to idealize the tubing by a continuous elastic support. This approach is based on a solid plate idealization of the tube sheet with modified elastic constants and the same dimensions as the solid plate. This involves the idealization of the structure with shell elements, allowing for branching, where it may be necessary to use transition elements and thick shells elements rather than thin shell elements, with additional solid elements, connecting both tube sheets. They are constructed compatible with the bending modes of the equivalent plate elements. The second step is then to compute stresses in the individual tubes and the stress distribution in the perforated plates from the gross deformation of the equivalent solid plates. Concerning the local stress distribution in the tube sheets, it will suffice to idealize only special regions of interest by using finite element idealizations which take into account the individual penetrations, tubes, etc., and using as boundary conditions the gross deformation or the membrane forces and moments of the equivalent solid plate so.

54760 (INIS-mf—4506, pp vp) **Parametric gross discontinuity interaction finite elements analysis between adjacent nozzles of a vessel.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The aim of this paper is a brief discussion of the effect of nozzles interaction in a shell in terms of the gross discontinuity stresses. However, while the peak stress distribution in an isolated nozzle has been largely studied in the open literature, there are not many contributions in this particular field. ASME III code serves as a general reference and its nozzles interaction rules will be compared with the results obtained by this analysis. Besides it is the principal aim of this paper to give a critical contribution in order to study the cases where simplified ASME Codes procedures are not applicable, without drawing a quite general conclusion on this topic. The paper is divided into three sections: analytical tools, a parametric analysis of a few cases, a comparison with ASME III code provisions.

54761 (INIS-mf—4506, pp vp) **Stresses from pressure, radial, and moment loads in cylinder-to-cylinder vessel by a finite plate method.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A problem common to the pressure vessel analyst is the evaluation of stresses in nozzle-to-cylinder structures subjected to internal pressure, nozzle axial force, and nozzle moments. In this paper, the finite-plate method is extended to include axial force and moments at the nozzle terminus. In this paper the theoretical development of the geometric and pressure load parameters are briefly reviewed. The analytical developmemt of the parameters for axial force, in plane moment, and out of plane moment is presented in detail. The range of applicability is reviewed for the various types of loadings. Finally, examples are presented for nozzle-to-cylinder structures loaded by pressure, axial nozzle force, inplane moment at the nozzle, and out of plane loading at the nozzle. Finite plate results are compared to the ORNL model data obtained by strain gage and 3D finite element methods and loaded by nozzle loads. The finite plate results versus the experimental data obtained by Van Campen and 3D finite element data for internal pressure are briefly discussed. In all instances the data compare favorably at the critically stressed location, which is at the nozzle-to-cylinder juncture. Finally, some observations are made with respect to the assessment of nozzle loads not analytically treated and thermal analysis of nozzle-to-cylinder structures.

54762 (INIS-mf—4506, pp vp) **Finite element, photoelastic, and stain gage stress analysis of a cylinder-to-cylinder structure.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this paper three independent methods are used to evaluate the stresses in a pressure loaded moderately thick cylinder-to-cylinder structure, with a curvature of 1.03. The experimental vessel is constructed of plastic and is first instrumented with a strain gage system designed to record strains in structures of plastic composition. Next, the vessel is subjected to a stress freezing process in order to provide photoelastically determined stresses in the intersection of the structure. Finally, two 3D finite element idealizations of the structure are used to assess model convergence and the stress levels in the transition. Tabulated stresses at the longitudinal and transverse sections are provided by 48 strain gage locations; 105 photoelastic points and 96 finite element discrete values. Within the critically stressed area of the juncture of the two cylinders, the data for the three methods at corresponding locations is shown to agree within a 3% variance. The 8-node isoparametric element with incompatible modes is shown to be a comparatively economical and accurate alternative to the experimental structural analysis for cylinder-to-cylinder components. Included within this paper is a brief discussion of the construction and testing of the experimental model and a.

54763 (INIS-mf—4506, pp vp) **Equivalent nozzle in thermomechanical problems.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

When analyzing nuclear vessels, it is most important to study the behavior of the nozzle cylinder-cylinder intersection. For the elastic field, this analysis in three dimensions is quite easy using the method of finite elements. The same analysis in the non-linear field becomes difficult for designs in 3-D. It is therefore necessary to resolve a nozzle in two dimensions equivalent to a 3-D nozzle. The purpose of the present work is to find an equivalent nozzle both with a mechanical and thermal load. This has been achieved by the analysis in three dimensions of a nozzle and a nozzle cylinder-sphere intersection, of a different radius. The equivalent nozzle will be a nozzle with a sphere radius in a given ratio to the radius of a cylinder; thus, the maximum equivalent stress is the same in both 2-D and 3-D. The nozzle examined derived from the intersection of a cylindrical vessel of radius R=191.4 mm and thickness T=6.7 mm with a cylindrical nozzle of radius r=24.675 mm and thickness t=1.350 mm, for which the experimental results for an internal pressure load are known. The structure was subdivided into 96 finite, three-dimensional and isoparametric elements with 60 degrees of freedom and 661 total nodes. Both the analysis with a mechanical load as well as the analysis with a thermal load were carried out on this structure according to the Bersafe system. The thermal load consisted of a transient typical of an accident occurring in a sodium-cooled fast reactor, with a peak of the temperature (540°C) for the sodium inside the vessel with an insulating argon temperature constant at 525°C. The maximum value of the equivalent tension was found in the internal area at the union towards the vessel side. The analysis of the nozzle in 2-D consists in schematizing the structure as a cylinder-sphere intersection, where the sphere has a given relation to the.

54764 (INIS-mf—4506, pp vp) **Elastic-plastic analysis of normally intersecting cylinders.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54765 (INIS-mf—4506, pp vp) **Analysis of vessels' supporting skirts for shear transmittal by bearing.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Vertical vessels are sometimes supported by means of a suitable structure resting on a reinforced concrete foundation (pedestal). This support structure between the vessel and the foundation may consist of an integral (or welded to the vessel) cylindrical shell termed a 'skirt'. A study has been conducted to investigate the effect of the relative stiffness of the skirt and its bearing flange to the supporting bumper and it was found that within the practical range of application it has a negligable effect. The results of the analysis indicate that the angle of contact between the skirt and the bumper for the practical range of application is between 220 and 230 degrees. The change in the angle within this range has no significant effect on the reactive forces (pressure between the skirt and the bumper). The distribution of the reactive pressure within the contact area as well as the internal forces in the skirt have been determined. The friction between the skirt bearing flange and the bumper has a small effect on the reactive pressure distribution and the internal forces in the skirt. This effect is mainly to reduce the peak in the reactive pressure distribution and makes it more uniform and also reduce the maximum values of the internal forces in the skirt.

54766 (INIS-mf—4506, pp vp) **Plastic limit load tests of intersecting cylinders.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Cylinder-cylinder intersection is a common configuration of structural components frequently encountered in the industrial installations concerned with the generation of energy such as nuclear reactors, petroleum refineries, pipe lines, etc. The load sustained by nozzles or branch pipes in most cases is comprised of internal pressure and external loads. A satisfactory analytical solution for the individual loadings, and for all diameter ratios has not yet been found despite several attempts over the years. The complexity of boundary conditions at the intersection is one of the major obstacles. This paper summarizes the results of series of elastic-plastic deformation tests performed on cylinder-cylinder intersection models made of either welded tubes or machined from a single plate. Methods of determining an experimental limit load and its physical significance are discussed. Experimental trends of the branch-pipe tee connections or nozzle-vessel attachments for individual loadings are first presented in terms of diameter ratios and thickness to diameter ratios. The out-of-plane couple loading is found to be the critical case. Subsequently pressure-couple interaction curves are shown. Presence of internal pressure increases resistance to the external couple. These interaction curves lend themselves to a simple mathematical relationship. Lower bound interaction formulae are thus proposed.

54767 (INIS-mf—4506, pp vp) **Use of vessel specific data in estimating brittle fracture probabilities.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54768 (INIS-mf—4506, pp vp) **Procedure for estimating the probability of flaw nondetection.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54769 (INIS-mf—4506, pp vp) **Crack initiation and propagation as a consequence of thermal shock.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54770 (INIS-mf—4506, pp vp) **Elastic analysis of torispherical, toriconical, and ellipsoidal pressure vessel heads.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54771 (INIS-mf—4506, pp vp) **Application of probabilistic fracture mechanics to the reliability analysis of pressure-bearing reactor components.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Since no failures in the primary reactor components have been reported so far, it is impossible to estimate the failure probability of those components just by means of statistics. Therefore the way of probabilistic fracture mechanics has been proposed. Here the material properties, the loads and the crack distributions are treated as statistical variables with certain distributions. From the distributions of these data probability density functions can be established for the loading of a component as well as for the resistance of this component. From these functions the failure probability for a given failure mode is easily obtained either by the application of direct integration procedures which are shortly reviewed here, or by the use of Monte Carlo techniques. The most important part of the concept is the collection of a sufficiently large amount of raw data from different sources. These data need to be processed so that they can be transformed into probability density functions. The method of data collection and processing in terms of histograms, plots of probability density functions etc. is described. The choice of the various types of distribution functions is discussed. As an example, the derivation of the probability density function for cracks of a given size in a component is presented. Here the raw data, i.e. the ultrasonic results, are transformed into real crack sizes by means of a conservative conversion rule. The true distribution of the indications is obtained by taking into account a detection probability function. The final probability density function is influenced by the fact that indications exceed certain values.

54772 (INIS-mf—4541, pp vp) **Determination of the largest stable suddenly appearing axial and circumferential through cracks in ductile pressurized pipe.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The flow area from a postulated pipe break is an important parameter in the design of safety devices and the evaluation of safety margins for nuclear steam supply systems. Present design criteria assume that very long stationary cracks may exist, resulting in the prediction of large opening areas and fluid forces. In this paper the largest stable cracks that could suddenly appear during normal operating conditions are determined by elastic-plastic dynamic finite element analysis. The stability of the hypothetical cracks is predicted by the J-integral ductile fracture criterion. The opening areas and the values of the J-integral for both axial and circumferential cracks are computed using the MARC-CDC general purpose finite element program. Analyses demonstrate that cracks in nuclear system primary piping must be greater than half diameter long for axial cracks, or half the circumference long for circumferential cracks before instability can occur during normal operation. These crack sizes, even when conservatively assumed to appear suddenly, open to areas which are very small fractions of the areas presently used in design.

54773 (INIS-mf—4541, pp vp) **Ductile failure of thin walled pipes with defects under combination of internal pressure and bending.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of the work is to evaluate the collapse of pipes containing axial defects and subjected to combinations of internal pressure and bending. The paper specifically considers ligament collapse due to applied pressure, collapse due to bending and ligament collapse due to internal pressure in the presence of bending. The major part of the experimental programme was carried out on 3.5 in. diam. mild steel pipes with wall thickness 0.064 in. Various lengths of axial defect were assessed for defect depth of 0.044 in., 0.050 in. and full penetration. The machined defects were 0.012 in, wide and nominally flat bottomed. As part of another exercise on depressurisation characteristics, data were obtained on pipes in the range 6 in. to 24 in. The results of the combined bending and pressure tests are presented as the hoop stress at failure for a given bending stress. A design curve has been constructed to show the form of the failure surface in terms of stresses remote from the defect. It has been shown as the defect size decreases the shape of the derived failure curve changes progressively to become geometrically similar to that for the unflawed pipe used as the basis for conventional design curves. These observations lead to a proposed design rule for pipes containing defects subjected to combined bending and pressure in which the failure is the ductile mode. This rule is that provided the axial stress due to bending does not exceed half the calculated hoop stress, then the hoop stress associated with the failure due to internal pressure of a pipe containing an axial defect may be calculated using the method stated above attributed to Kiefner et al.

54774 (INIS-mf—4541, pp vp) **Fracture dynamics of a propagating crack in a pressurized ductile cylinder.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A suddenly-introduced axial through-crack in the wall of a pipe pressurized by hot water is allowed to propagate according to Weiss' notch-strength theory of ductile static fracture. For this somewhat ductile material of A533B steel, Weiss' criterion was extended of dynamic fracture without modification. This dynamic-fracture criterion enabled a unique comparison to be obtained for the results of ductile-fracture with those of brittle-fracture in a fracturing A533B steel pipe. Since the pipe cross-sectional area is likely to increase with large flap motions under ductile tearing, a large deformation-shell-finite-difference-dynamic-code which includes rotary inertia was used in this analysis. The uniaxial-stress-strain curve of A533B steel was approximated by a bilinear stress-strain where Von-Misses yield criterion and associated flow rule were used

in the elastic-plastic analysis. The fluid pressure was assumed constant and thus pipe flaps are only lightly loaded by pressure in this analysis. In previous publications, the authors have compared their preliminary results for the shell motion obtained through their model for a fracturing pipe with those of Kanninen, et al., and Freund, et al., to evaluate the effects of pressure loading on the crack flaps and the differences between small and large deflection results. In this paper, the differences in crack-propagation behavior of a fracturing pipe composed of the same A533B but subjected to a brittle or a ductile-fracture criterion are discussed. An important conclusion in fracture dynamics derived from analyses is that a smoothly-varying crack velocity will require a non-unique crack-velocity-versus-dynamic-fracture-parameter-relation while a unique and smoothly-varying crack-velocity-versus-dynamic-fracture-parameter-relation will demand an intermittently-propagating crack.

54775 (INIS-mf—4541, pp vp) **Investigation of fluidelastic instabilities in tube banks subjected to fluid cross-flow.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The experimental and theoretical work summarised here is part of a continuing general study of heat exchanger tube vibration, and is concerned with the particular problem of the self-excited, steady-state vibrations of arrays of tubes in cross-flow. The basic experimental work is the measurement, using strain gauges, of the motions of tubes located in the front, centre and back rows of a 10 row array. The Perspex tubes are of 1 diameter and are mounted in a cantilevered configuration in a wind tunnel of 18" square working section. In the experiments the damping of the tubes in the array is first determined by exciting the instrumented tubes into free vibration and the array is then mounted in the wind-tunnel and the dynamic deflections of the tubes measured as a function of airspeed. The data from the measurements made so far are in general agreement with other workers. In the theoretical work it is shown that in the case of single-span tubes which receive the cross-flow over the whole span, the mode-shape is unimportant, a result which seems to disagree with earlier work. When the flow meets only a part of the span, however, the critical velocity is influenced not only by the concentration of the flow, but by the mode-shape of the tube and the part of the span to which the flow is applied. Calculations have also been made for the case of a multi-span tube with partial admission in the first and last bays, and here it is found that the critical velocity can be strongly influenced by conditions in the end bays. These results are believed to be new. Further experimental work is concerned with verification of the theoretical results on the effects of mode shape and partial admission and of initial turbulence. In general, the experiments on partial admission agree qualitatively with the theoretical work, but quantitative results are only preliminary. The effect of turbulence is to reduce the critical velocity.

54776 (INIS-mf—4541, pp vp) **Vibrations of tube arrays in transversal flow.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The vibrations induced in tube arrays by a transversal flow are of great practical interest because of their destructive effects especially on heat exchangers. Though turbulence can significantly excite the tubes by itself, most intense vibrations are still caused by two fluidelastic phenomena: the 'lock-in effect', the whirling instability. The study described in this paper gives important information concerning characteristic parameters about both phenomena, in the case of tube arrays. The work is mainly an experimental one though models are also developed: an equilateral pitch bundle (p=1.5 D with D=tube diameter) was tested. Tubes damping and first eigenfrequency, flow velocity were explored in a large domain. Vibratory levels of the tubes were measured and critical points are plotted on the fluidelastic parameters diagram. Several bundles with various usual pitches and arrangements (in line or staggered) were tested. Critical velocities have been measured and the whirling instability characteristic coefficient tabulated. A complementary experiment is made on tube rows with various pitches. This gives valuable information concerning the look-in domain. Furthermore this puts in evidence the important effect of a frequency difference between two adjacent tubes on the whirling critical velocity.

54777 (INIS-mf—4541, pp vp) **Flow induced vibrations of piping.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In order to design the supports of piping systems, estimations of the vibrations induced by the fluid conveyed through the pipes are generally needed. For that purpose it is necessary to calculate the model parameters of liquid containing pipes. In most computer codes, fluid effects are accounted for just by adding the fluid mass to the structure. This may lead to serious errors. This paper presents a method to take into account these effects, by solving a coupled mechanical-acoustical problem: the computer code TEDEL of the C.E.A /D.E.M.T. System, based on the finite-elements method, has been extended to calculate simultaneously the pressure fluctuations in the fluid and the vibrations of the pipe. By this way the mechanical-acoustical coupled eigenmodes of any piping system can be obtained. These eigenmodes are used to determine the response of the system to various sources. Equations have been written in the hypohesis that acoustical wave lengths remain large compared to the diameter of the pipe. The method has been checked by an experiment performed on the GASCOGNE loop at D.E.M.T. The piping system under test consists of a tube with four elbows. The circuit is ended at each extremity by a large vessel which performs acoustical isolation by generating modes for the pressure. Excitation of the circuit is caused by a valve located near the downstream vessel. This provides an efficient localised broad band acoustical source. The comparison between the test results and the calculations has shown that the low frequency resonant characteristics of the pipe and the vibrational amplitude at various flow-rates can be correctly predicted.

54778 (INIS-mf—4541, pp vp) **Experimental study of peripheral problems related to liquid flow induced vibration in heat exchangers and steam generators.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Real prototype heat exchangers deviate from laboratory tube bundles. In the work reported here, numerous experimental tests have been conducted to determine the effect on permissible design velocity limits of these deviations. All tests have been conducted in a horizontal water tunnel containing tube bundles of contemporary interest. Tests have been conducted to determine whether or not open tube lanes will serve to trigger hydroelastic instabilities at abnormally low velocities. It is found that, in fact, they do not. Further tests were conducted to investigate the effect of varying the clearance between the bundle and the tunnel wall. Results indicate that a clearance of not less than half a tube diameter prevents local vibration problems. The effect on vibration of various shapes of baffle plates located along the tunnel wall was investigated. Preferred baffle plate designs have been established. Clearances of one tube bundle gap width between baffle plates and adjacent tubes are shown to be desirable. Mixed bundles of tubes of different frequencies were tested. Vibration test demonstrated that this is not the way to improve heat exchanger design. The effects of locating baffles in the bundle inlet region were tested. It was found that the distance between the plate and the bundle was not of critical importance. Other geometric effects were studied. The first hydroelastic tests on clamped-simply supported tube bundles have now been completed. The new data are found to fit remarkably well on the previously used stability diagram. At the time of writting, the effect of clearances at the tube end supports is being studied. With controlled clearances in the laboratory, it is found that a knocking action occurs at these supports even at extremely low velocities. The implication of these tests, as they pertain to multi-span heat exchangers is discussed.

54779 (INIS-mf—4541, pp vp) **Non-axisymmetric behavior of a thermally loaded model tubesheet.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of the paper is to report on an experimental investigation carried out with an epoxy resin model of a tubesheet with two passes and a wide diametral lane. Various thermal loading configurations both symmetric and non-symmetric have been applied and, in addition, the effect of rate of temperature increase has been studied. A time similarity ratio of 100 is achieved with epoxy resin as compared to steel so that transients are analyzed in a quasi-static fashion. For example, with the epoxy model, steady state is attained in 6 minutes in the perforated zone and in 150 minutes in the solid diametral lane, the corresponding values for a steel specimen of the same dimension are 3.5 seconds and 85 seconds respectively. A first series of experimental results for temperatures and displacements have been compared with those of plane and axisymmetric finite element programmes, with the following immediate conclusions: the temperature distribution through the thickness of the tubesheet in the ligament region agrees with the results of the numerical computations. As the rate of change of temperature increases, a point is reached where important temperature gradients appear not only on the originally cold end but at both ends of ligaments. The temperature distribution in the diametral lane corresponds to that of a wide beam thermally loaded on three sides. The diametral lane has an important influence on the overall displacement of the tubesheet during the transient conditions. As steady state conditions are reached however, the results tend to agree with those of the axisymmetric all-perforated geometry.

54780 (INIS-mf—4541, pp vp) **Experimental verification of U-bolt connection for pipe whip restraint design.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

For pipe whip restraints, to prevent the broken pipe from damaging other safety class equipment, ductile material is used for the restraint structure so that large plastic deformation is utilized to

absorb the released energy from the pipe. One of the most efficient and the simplest restraints is the steel U-bolt system which requires the pin and clevis for connection to the embedment plate. This system is not only expensive but also requires that embedment plate be designed to take tension. However, it simplifies the analysis such that only tension deformation is considered in the U-bolt. This tension only deformation is important, because the acceptable deformation criterion in the ANSI N176 Standard, 'Design Basis for Protection of Nuclear Power Plants against Effects of Postulated Pipe Rupture', is 50% of the minimum ultimate 'uniform' strain. As an alternative, an anchor bearing plate system is presented, which was developed for the U-bolt connection. Since this connection is not free to rotate, tension and bending deformations in the U-bolt have to be considered simultaneously. The first problem encountered is to determine the acceptable deformation criterion in compliance with the aforementioned ANSI N176 Standard. The general purpose elasto-plastic finite element programs could be used to calculate the effect of tension-bending interaction in large plastic deformation regions. Since the final results depend on the modeling technique and the material law assumed, the validity of the results can only be verified by testing. The allowable deformation criterion was determined under combined tension and bending test. Seven ASTM A307A steel rods were tested, one was tested in direct tension as a control specimen, the other at nominal angles of 5^0, 10^0, 20^0, two at each angle, until rupture. To determine the effect of temperature and strain rate, DIN Material No. 1.8817 or DIN Designation 17 MnMo V64 was tested at a strain rate of 4 cm/cm/sec.

54781 (INIS-mf—4541, pp vp) **Pipe whip analyses on the bundle tubes in a sodium-water steam generator.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Neratoom B.V. was to prove that a fractured tube in sodium-water steam generators could not cause an adjacent tube to break due to mechanical interactions during the pressure peak of the sodium-water reaction. The maximum calculated kinetic energy of the tube at the potential moments of impact with an adjacent tube is used as an input parameter for the experiments. The deformation and velocity calculations of the whipping tube were performed at ECN using the finite element program MARC. The impact tests were carried out at the Materials Institute of TNO in Apeldoorn. The paper covers the ECN-calculations for two types of steam generators, a straight-tube and helical-coil type. For the straight-tube steam generator a calculation is carried out for the case of a longitudinal fracture of a tube, the latter being loaded in a transverse direction. The tubes of the helical-coil steam generator are of a more complex geometry. Therefore, three possible fracture locations and two fracture types are assumed. One of these combinations causes three-dimensional displacements to occur. All calculations include dynamic effects, large displacements, plasticity and displacement dependent jet reactions. From the velocities at the moment of a possible impact of the whipping tube with an adjacent one, the total kinetic energy is calculated. From the load-displacement curves the total energy supplied to the tube is determined. The results of the calculations are compared with analytical solutions of penduli. In these solutions use is made of the locations of the plastic hinges resulting from the finite element calculations. The results of the analytical solutions show a shorter time period between the moment of fracture and the moment of a possible impact with an adjacent tube.

54782 (INIS-mf—4541, pp vp) **Dynamic crack propagation in two- and three-dimensional solids.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper describes a numerical approach to the prediction of crack propagation in two- and three-dimensional structures. The work is primarily aimed at the analysis of dynamic crack growth in pressurized pipe lines. A cylindrical pipe is considered in which a crack is assumed to propagate along a generator. Large deformation effects must be accounted for in order to simulate the gross geometrical changes which occur in the crack tip zone. Loss of pressurization in regions behind the crack tip must also be considered. Two general approaches are open. A limiting crack tip stress for propagation can be postulated, or an energy rate balance criterion can be adopted. The finite element method is employed for model simulation. Parabolic isoparametric elements are utilized which are numerically integrated using a two-point Gauss rule in each direction. The dynamic equation of equilibrium is solved by use of an explicit time marching scheme. A special mass lumping scheme is adopted and plasticity effects and large deformations, subject to the condition of small strain, are permitted. The problems of both a stationary and a propagating crack in a pressurised pipeline are numerically solved for. The stationary crack solution is compared with Ayres' results and the correlation obtained is reasonable. A dynamically propagating crack is then considered and depressurization effects are accounted for. Velocities of propagation of the crack and the eventual arrest lengths are computed for various values of initial and subsequent fracture toughnesses. Finally the effects of a closure in the pipe are considered. The influence of a pipe closure in the vicinity of a propagating crack is demonstrated.

54783 (INIS-mf—4541, pp vp) **Experimental and simulation studies of a 3-dimensional heat exchanger tube with baffle interaction.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Vibration of heat exchanger tubes can result in fretting wear at baffle supports. The experimental apparatus consisted of a vertically cantilevered tube passing through an instrumented annulus. Excitation was provided by a pair of stepping motors mounted on the tube's free end with spinning eccentric masses. The annulus was a ring supported by four piezoelectric force transducers which measured impact and sliding forces. The precise position of the tube was monitored by two inductive proximity probes. A set of nine experiments were performed at three excitation frequencies and three ratios of excitation forces. The optimum finite element model consisted of seven beam elements. Concentrated masses, torsional inertias and diametral inertias were included to model the experimental apparatus. The tube/annulus stiffness was determined by comparing the rise time of the simulated impact force to that observed experimentally. The tube behavior was simulated by numerically integrating the equations of motion resulting from the finite element model. Modal superposition was used with six clamped-free modes and four clamped-pinned modes. Comparison of the predicted results of the RMS impact and sliding forces with the experimentally measured values showed a median per cent difference of 11%; the simulated values were always higher. The differences were larger at low force levels. The sensitivity of the model to a number of parameters has been investigated. The 20 hz simulations were repeated using coefficients of friction of 0.05, 01 and 0.2. Other parameters were considered in 20 hz simulations using a force ratio of three. In general, it was observed that the model was quite insensitive to changes in the parameters whose values had to be estimated.

54784 (INIS-mf—4541, pp vp) **Analysis of leakage areas in pipes.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In order to facilitate a realistic approximation of jet forces due to longitudinal cracks in pipes under pressure and its variation with time, exact calculations of leakage area and cracks border form during opening, are required. Complex phenomena of dynamic plastification and depressurisation of the system have to be taken in consideration. The opening areas of longitudinal cracks are computed by an elastic-plastic large displacement dynamic finite element analysis using the general purpose program MARC. Results of these analyses are compared with experimental data. Plots showing the variation with time of displacements and stresses are presented. Three finite element models, from simple to complex geometries, are presented. Changing boundary conditions and time steps are explained. Fracture mechanics parameters (J-Integral) are computed around the crack tip. These values are compared with experimental data in order to show the tendency of the crack to propagate or to arrest. The longest stable crack is calculated for each Finite Element Model. Elastic-plastic dynamic phenomena of a running crack in a pipe under pressure are presented, and its computation with an elastic-plastic large displacement dynamic finite element program is explained.

54785 (INIS-mf—4541, pp vp) **Piping shear lug stress analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Due to space limitations present in many of the current nuclear power plants, it is frequently necessary to apply restraints skewed to a piping system's axis in order to restrain the piping against hydraulic transient and seismic loads. In order to assure that the restraints function as required, shear lugs are often used to eliminate relative motion between the pipe and the restraint. Detailed stress analyses of the pipe-lug system are presented and expressions for the needed indices are deduced. The analyses are accomplished through use of three-dimensional finite-element modeling employing the computer program SAP IV. Eight node brick elements are used to represent both the pipe and the lug. The resulting mesh consists of 316 elements and 558 nodes and incorporates the symmetry aspects of the physical system. The mesh is a graded one with small elements employed in the area of the lug. A check on the expected accuracy is obtained through a comparison with both an approximate elasticity solution and a proprietary computer program ISOPAR-SHL. The latter allows local stress concentration regions to be modeled by using higher order three-dimensional elements (36 nodes) while the remaining structure is represented by curved shell elements, with transition elements connecting the two. Numerical results are carried out for typical pipe diameters and loadings are then interpreted and recast in terms of the Code design

criteria. They are furthermore compared with the results obtained by employing the procedure given in WRC Bulletin 198. This comparison illustrates the conservativeness of the WRC approach, especially for small lugs and lugs whose long dimension is in the circumferential direction. In particular, for a circumferential lug on a 12 in. diameter pipe subjected to loading representative of the up set condition, use of the WRC procedure yields results which are larger by a factor of four for the shear term and by 1.5 for the bending term.

54786 (INIS-mf—4541, pp vp) **Effective elastic constants for perforated plates with square penetration patterns.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54787 (INIS-mf—4543, pp vp) **Creep analysis by the path function method.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The finite element method has become a common analysis procedure for the creep analysis of structures. As early as 1966 Greenbaum used a finite element program based on an initial strain approach to solve for stresses and displacements in axisymmetric problems. Since then several other algorithms have been developed along lines which are similar to Greenbaum's in their treatment of the creep component of strain. Other related approaches are presented in the survey by Gallagher, ORNL 4756 (1973). The most recent programs are designed to handle a general class of material properties and are able to calculate elastic, plastic, and ceep components of strain under general loading histories. The constant stress approach is too crude a model to accurately represent the actual behavior of the stress for large time steps. The true path of a point in the effective stress-effective strain sigmasup(e)-epsilonsup(c) plane is often one in which the slope is rapidly changing. Thus the stress level quickly moves away from the initial stress level and then gradually approaches the final one. The result is that the assumed constant stress level quickly becomes inaccurate. What is required is a better method of approximation of the true path in the sigmasup(e)-epsilonsup(c) space. The method described here is called the path function approach because it employs an assumed function to estimate the motion of points in the sigmasup(e)-epsilonsup(c).

54788 (INIS-mf—4543, pp vp) **Inelastic analysis of metal structures. Some applications.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In the design of components for the power industry in general and the nuclear industry in particular, the engineer is called upon to perform inelastic analyses for the satisfaction of certain code and regulatory requirements. In other situations inelastic analysis is used to investigate the cause of failure of a component or to gain further insight of test results. In all these cases a design limit or a failure criterion is set for evaluating the analytical results, but in most cases it is left up to the analyst to choose the appropriate material constitutive relations. Ideally, the constitutive relations should model the material behavior in the mode of failure or deformation under consideration. For example, yield stress, strain rate dependence could be of major importance in dynamic plasticity at high strain rates. Similarly, deformation plasticity theory was found to give better results than incremental theory in plastic buckling. In many cases however, the analyst, especially if the uses general purposes programs, has a very limited choice in the constitutive relations for use in the analysis. In addition to the above considerations, the analyst has to make sure that his analysis results could be used easily with the failure criteria adopted. For example, in evaluating creep-fatigue damage, currently there are several damage criteria, some of them make use of plastic and creep strains separately, while others use strains and strain rates without definite distinction between creep and plastic strains. In these cases the analyst must make sure to adopt the appropriate constitutive relation.

54789 (INIS-mf—4543, pp vp) **Inelasticity and the ASME code.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The ASME Boiler and Pressure Vessel Code sets rules that constitute requirements for the Construction of nuclear power plant items. The term construction includes material design, fabrication, testing, inspection, etc. These requirements are necessary but may not be sufficient for compliance with the Code. The manufacturer has the responsibility for the structural integrity of the completed item for the conditions stated in the Design Specifications. Thus in addition to meeting the rules of the Code, the manufacturer must take other measures to assure the structural integrity of the component. In terms of design and analysis, it is here shown that the primary stress limits are set such that the stress intensities in essence remain elastic. This is true even though the related safety factor for various combinations of primary membrane and primary membrane plus primary bending stress is set by limit analysis and varies from 1.27 to 1.67. This is also true of austenitic stainless steel in which the allowable Ssub(m) is thirty-five percent higher than for ferritic steels. These primary stress limits are intended to prevent plastic deformation and to provide a nominal factor of safety on the ductile burst pressure. By virtue of the fact that the multiaxial calculations to meet these limits are done in the elastic range, they lead to results in which we can place a high degree of confidence. The reasons for this based on the applicable material parameters, constitutive equations and computation methods are discussed.

54790 (INIS-mf—4543, pp vp) **Remarks on the tensorial formulation of constitutive laws describing mechanical hysteresis.** 1977. (In French).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The paper is devoted to a new approach of the tensorial formulation of constitutive laws describing hysteresis for simple non-aging inelastic materials which are supposed homogeneous, isotropic, at rest in the initial configuration. The approach is based on the superposition of two types of stresses sigmasub(a) and sigmasub(h) which sum is the effective stress sigma. The use of such a superposition principle for stresses is connected with experimental results briefly summarized as follows: under large strain or low-cycle fatigue, microstructure and macroscopic properties of solids become steady, well-defined, weakly dependent of the initial state. The sigmasub(a) contribution deals with these steady aspects and the sigmasub(h) term is a hereditary perturbation. Concerning the sigmasub(a) contribution, the well-known models with springs and friction-slider elements, unrealistic in 3 dimensions, are used as an heuristic tool. A scalar auxiliary function W, closely related to dissipated energy is introduced. The approach concerns large strain, gives asymptotic properties in agreement with classical theories, allows -by the use of one law- to take into account several observed properties, introduces only a small number of parameters -of simple physical interpretation-, is compatible with numerical technics for approximations of associated Lagrangian functions on a suitable linear space (a simple boundary value problem is presented in the case of the low-cycle of a stainless steel structure).

54791 (INIS-mf—4543, pp vp) **Inelastic thermodynamically coupled response and evaluation of temporal operators.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54792 (INIS-mf—4543, pp vp) **Model for rate-dependent but time-independent material behavior in cyclic plasticity.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

It is the purpose of this paper to present a model for rate-dependent but time independent material behavior under cyclic loading in the plastic range. What is referred to as time independent behavior here, is the absence of creep and relaxation phenomena from the behavior of the model. The notion of plastic internal variables (piv) is introduced, as properly invariant scalars or second order tensors, whose constitutive relations are rate-type equations not necessarily homogeneous of oder one in the rates, as it would be required for independent plasticity. The concept of a yield surface in the strain space and a loading function in terms of the total strain rate is introduced, where the sign of the loading function defines zero or non-zero value of the rate of piv. Thus rate dependence is achieved without time dependent behavior (no creep or relaxation). In addition, discrete memory parameters associated with the most recent event of unloading-reloading in different directions enter the constitutive relations for the piv. A particular form of the constitutive relations is assumed, where the rate of piv is a linear combination of the strain rate components, with coefficients depending on the second invariant of the strain rate tensor, which can be viewed as a scalar measure of the rate of deformation in the multiaxial case and a direct generalization of the uniaxial strain rate. This leads to a particularly simple form of the constitutive relations resembling the ones for rate independent plasticity. The uniaxial counterpart would be a relation between the plastic strain rate (as one of the piv) and the total strain rate through a plastic modulus which depends on the strain rate, the piv, and the discrete memory parameters.

54793 (INIS-mf—4543, pp vp) **Failure of material in the low cycle fatigue range.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

It is significant for the material behavior in the low cycle fatigue (LCF) range, that deformations occur in the highest stressed zones during each loading cycle. They are regarded to be decisive for the material damage. Failure through crack formation, which possibly might result from this, is usually controlled by failure curves (i.e. strain amplitude vs. cycles-to-failure). These failure curves are determined experimentally under constant mean strain. If, however, the mean strain under service conditions is not stable, but increases incrementally, crack initiation will occur at a lower number of cycles. It was the purpose of the investigations described

to analyze the conditions under which such an incremental increase of the mean strain takes place. This can be accomplished by means of a simple mechanical model, namely a bar with rectangular cross section made of linearelastic-perfectly plastic material, which is loaded by a constant tensile stress sigmasub(t) and a superimposed reversed bending strain with the amplitude epsilonsub(b). By applying the results of this model to technical components it can be shown that a similar deformation mechanism is possible, if during each loading cycle the component is subjected to primary membrane stresses together with primary bending stresses or secondary stresses. Assuming the linearelastic material range extends over 2 sigmasub(y) or 2 epsilonsub(y) respectively, there does not occur an incrementally increasing mean strain or any cyclic plastic deformation as long as the resulting maximum stress does not exceed twice the yield strength -as it is usually required by the technical codes.

54794 (INIS-mf—4543, pp vp) **Adequacy of the structural model of elasto-visco-plastic medium under variable repeated non-isothermal loading.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The presented paper concerns some results of theoretical and experimental investigations at proportional variable repeated non-isothermal loading. The generalization of the Masing's principle under such conditions is obtained. The stress-strain curves are determined by both the temperature and strain history and may be described by two one-dimensional functions in accordance with some rules (the part of pre-history being forgotten). The time-dependent behavior of the model was investigated under non-symmetric loading condition. The well-known effects of cyclic creep (at stress controled cycle) and cyclic relaxation (strain control) are reflected. The values of cycle parameters (mean stress and amplitude) at which the strain grows unlimitedly may be predicted. The proposed model describes also some peculiarities of cyclic creep and relaxation behavior connected with the previous deformation history. It is shown that under definite conditions the ordinary direction of the loop translation may be changed to the opposite. Under non-isothermal loading these processes are controled by the temperature values at the moments when the stresses are extreme. The experimental investigations (the torsion of thin-walled tube specimens) for several structural alloys were carried out. They included the isothermal tests for the model parameters determination and the checking the adequacy of the model at various programs of isothermal and non-isothermal loading. All the experimental data obtained are in sufficiently good correspondence (both qualitative and quantitative) with the behavior predicted by the model.

54795 (INIS-mf—4543, pp vp) **Steady cyclic stress analysis for elasto-plastic structures subjected to repeated actions of load and temperature.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The problem of the direct (without step-by-step analysis of all the deformation history from the very beginning of the load) determination of the steady cyclic stresses and strain rates is considered for the three-dimensional elastic-perfectly plastic continuum. The mentioned problem is formulated as a maximization (or minimization) principle for corresponding functionals. Two statements have been suggested. I) From all the kinematically admissible cycles of plastic strain rates and corresponding residual stress rates (securing the acceptability of the total stresses in any point of the body at any time-moment) the actual steady cycle is such that the total work performed in it by the difference between total and yield stresses becomes maximum. It is shown that the well known static (Melan) and kinematic (Koiter) shakedown (non-shakedown) theorems directly result from the formulated principle assuming that the steady behavior of the body is perfectly elastic (or, correspondingly, that the plastic strain rates differ from zero). II) From all the initially residual stresses fields at which the total stresses are statically possible and acceptable at any time-moment and the strain rates depending upon them are compatible in the actual steady cycle are realized the ones which ensure the minimum of the total elastic energy corresponding to the difference between the residual stresses at the beginning and at the end of the cycle. The extreme principles suggested and proved may be practically used for the exact or approximate determination of the steady cyclic stresses and strain rates due to the given forces and temperature fields.

54796 (INIS-mf—4543, pp vp) **Pressure vessels and pipe components strength under low-cycle loading.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54797 (INIS-mf—4543, pp vp) **Numerical and experimental comparison of plastic work-hardening rules.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this paper is to describe recent numerical and experimental correlation studies of several plastic work-hardening rules. The mechanical sublayer model and the combined kinematic-isotropic hardening rules are examined and the numerical results for several structural geometries are compared to experimental results. Both monotonic and cyclic loads are considered. The governing incremental plasticity relations are developed for both work-hardening models. The combined kinematic-isotropic hardening model is developed in terms of a ratio γ which controls the relative contribution of kinematic hardening (yield surface translation) and isotropic hardening (yield surface expansion). In addition to making use of a uniaxial stress-strain curve as input data, the model allows for the input of a yield surface size vs. uniaxial plastic strain curve obtained from a cyclic uniaxial reverse loading test. The mechanical sublayer model is developed in general form and a new method for determining the sublayer parameters (stress weighting factors and yield stresses) is presented. It is demonstrated that former procedures used to obtain the sublayer parameters are inconsistent for multiaxial loading. Numerical and experimental results are presented for a cylinder, circular plate with punch, and a steel pressure vessel. The numerical results are obtained with the computer program AGGIE I. The comparison study indicates that reasonable agreement is obtained with both hardening models; the choice depending upon whether the loading is monotonic or cyclic.

54798 (INIS-mf—4543, pp vp) **Constitutive relations for non-elastic deformation.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The constitutive relations that are described are based on the use of deformation state variables (internal variables). The use of state variables for the description of the non-elastic deformation of solids is neither trivial nor self-evident. The purpose of such a formulation is to account for the effects of prior deformation or processing in terms of a small number of variables whose values can be established by tests at the current state of the material. If such a description is possible, the effects of past history are fully accounted for by the state variables and the description of the deformation can be a time-local description. The search for a state variable description requires a theoretical framework in which the experimental questions can be posed. Such a phenomenological theory was formulated by Hart, Acta Metallurgica 18(1970)599, in connection with a critique of deformation phenomenology. The critique considered time dependent recoverable strain (anelastic strain) as well as unrecoverable ('plastic') strain. However, the analysis was directed principally to the unrecoverable strain component. More recently a complete model has been described that treats both non-elastic components. This current model describes the full range of deformation phenomena including loading transient behavior and Bauschinger effect. The formulation is fully three-dimensional and provision is made for describing texture anisotropy if necessary.

54799 (INIS-mf—4543, pp vp) **Unifying concepts in plasticity theory and related matters in numerical analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper reviews a rate-independent theory (or class of theories) of multiple-mode plastic straining which unifies various constitutive equations of macroscopic solids and single crystals. Some consideration is given to the relationship between the multiple-mode theory and thermodynamic concepts; including physical aspects of finite distortion of metal crystals. Uniqueness criteria and related minimum principles in incremental (or 'rate-type') boundary value problems are presented for the general class at finite strain. Special circumstances (one being infinitesimal strain) are defined under which the uniqueness criteria assure convergence of a form of finite element approximation in the boundary value problem. Extensive reference is made to recently published work of Hill, Rice, Sewell and Havner. A symmetry postulate pertaining to the 'effective hardening moduli' plays a key role in the general theory. This postulate permits the adoption of Sewell's multiple-mode saddle function as a potential for stress and plastic mechanism rates and leads to the connection between uniqueness and (rate-type) minimum principles. The postulate has a remarkable consequence for application of a simple form of the theory to single crystals in the tensile test. At small strain this theory reduces to the classical Taylor hardening of crystals, which has had wide application in micromechanical calculations of crystalline aggregate models. At infinitesimal strain, and at finite strain when the two dominant principal stresses are everywhere tensile, additional minimum principles are given for the 'self-straining problem' which permit the independent variation of displacement and plastic mechanism rates.

54800 (INIS-mf—4543, pp vp) **Approximate methods for the prediction of creep rupture in components.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The present paper considers the prediction of creep and creep rupture in thick-walled tubes and solid cylindrical bars under pure torque. Complicating factors such as anisotropy, inhomogeneity, and initial plastic loading strain which beset any method of analysis are

discussed. In particular, the effect of pre-relaxation on the subsequent life of the component, and the prediction of those effects by reference stress methods are examined. A spectrum of engineering-type metals have been included in the investigation; these are a 0.24% carbon steel at 450°C, a type 316 stainless steel at 600°C, an aluminium alloy (RR58) at 180°C, and a commercially pure copper at 250°C. The components and testpieces were cut from a variety of initial forms, thus the type 316 stainless steel and the copper were in rolled bar form, while the aluminium alloy was in rolled plate condition. The 0.24% carbon steel was initially in the form of a block from an ingot. The successful application of the predictive method, including coverage of such a diverse variety of metals and forms would encourage expectations of the general applicability of the technique. While creep deformation paths, of up to 1 or 2% proved generally predictable by the reference stress method, tertiary creep strain and rupture time predictions proved less satisfactory. Creep rupture time predictions could, however, be made by methods previously developed by the authors, though these required tensile creep rupture data. Use of constant stress, as distinct from constant load, reference stress tests improved tertiary creep strain and rupture time predictions. For low deformation creep predictions, as might have been expected, no great advantage was obtained by using constant stress tests.

54801 (INIS-mf—4543, pp vp) **Fatigue reliability of structural members under combined axial mean and alternating stresses for AISI 1018, 1038, 4130 and 4340 steels.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The failure governing strength distributions of round specimens subjected to a mean axial stress onto which alternating tensile and compressive axial stresses are superimposed, for 10^6 and $2x10^6$ cycles of operation, are determined. AISI 1018, 1038, 4130 and 4340 steel 3/8-in. diameter, specimens are tested on an axial, Baldwin-Lima-Hamilton Universal Fatigue Testing Machine. Staircase-testing is used to determine the endurance strength distributions at various ratios of alternating to mean tensile stresses. Testing is accomplished at a sufficient number of ratios to enable the construction of a distributional, statistical Goodman strength diagram for each one of the four steels. A digital computer program of the Reliability Engineering Research Laboratory at The University of Arizona, Program LEAST, is used to determine the equation of the distributional Goodman diagram which best fits the loci of the experimental data at stress ratios between zero and infinity.

54802 (INIS-mf—4543, pp vp) **Shakedown analysis through incremental procedures.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54803 (INIS-mf—4543, pp vp) **Elevated temperature inelastic analysis of metallic media under time varying loads using state variable theories.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In the present paper a general time-dependent inelastic analysis procedure for three-dimensional bodies subjected to arbitrary time varying mechanical and thermal loads using these state variable theories is presented. For the purpose of illustrations, the problems of hollow spheres, cylinders and solid circular shafts subjected to various combinations of internal and external pressures, axial force (or constraint) and torque are analyzed using the proposed solution procedure. Various cyclic thermal and mechanical loading histories with rectangular or sawtooth type waves with or without hold-time are considered. Numerical results for these geometrical shapes for various such loading histories are presented using Hart's theory (Journal of Engineering Materials and Technology 1976). The calculations are performed for nickel in the temperature range of 25°C to 400°C. For integrating forward in time, a method of solving a stiff system of ordinary differential equations is employed which corrects the step size and order of the method automatically. The limit loads for hollow spheres and cylinders are calculated using the proposed method and Hart's theory, and comparisons are made against the known theoretical results. The numerical results for other loading histories are discussed in the context of Hart's state variable type constitutive relations. The significance of phenomena such as strain rate sensitivity, Bauschinger's effect, crep recovery, history dependence and material softening with regard to these multiaxial problems are discussed in the context of Hart's theory.

54804 (INIS-mf—4543, pp vp) **Constitutive theory for metal creep.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The objective of this research has been to establish a constitutive theory for the elevated temperature behavior of metals capable of predicting the inelastic strain response for an arbitrary stress history. To determine the phenomenological description of a specific material, a series of load rate, strain rate, and creep tests were performed on wrought Udimet 700 at 1700°F. The analysis of the data showed the quasi-static creep strain rate response was bounded from above and below. The upper bound corresponded to the locus of maximum primary creep rates, and was observed in the higher of the quasi-static load tests. The lower bound was the minimum creep rate, and was observed in the creep tests, strain rate tests, and at the low load rate tests. Since the maximum primary creep rate was the same for high loading rates and the minimum creep rate was a function of stress, the creep curve was found to be time-translation invariant in these cases. The concept of transition from one creep rate to another was shown to depend on a material stress rate coordinate which was derived from the concept of a thermally activated process time which was stress dependent. The predictions of the proposed theory, strain and time hardening, and Besseling were compared to the response data from a series of cyclic creep and relaxation experiments. The results showed that, in the majority of cases, the new theory was better than the other theories. However, based on these correlations, it was also shown that the concept of a maximum primary creep rate must include a representation for static and dynamic recovery. This concept was shown to be consistent with the findings of others and should be included in future work using the proposed constitutive model.

54805 (INIS-mf—4543, pp vp) **Determination of the mechanical state of a cold-worked structural component.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A program to evaluate complete stress-distributions has been developed and applied to the extrusion process. Elastic-plastic theory relates rate of stress and rate of strain, with current stress and deformation history influencing the coefficients. When plastic flow sets in, the tangent modulus is of the order of the stress for many metals, and this circumstance, combined with the rate relations, introduces the need to include convected translational and rotational terms and geometrical non-linearities into the analysis. These can be conveniently incorporated into the analysis by utilizing a referential or Lagrange type formulation. However, the incremental or fluid-like nature of plasticity commends a spacial or Euler type formulation, and this can be achieved, in combination with the advantage of a fixed reference frame, by using a sequentially updated reference state for each time step in the calculation. This permits convenient inclusion of nonlinear terms associated with the development of finite deformation. A finite element program incorporating the effects mentioned above was developed to analyze extrusion problems. In order to satisfy the boundary conditions of the metal sliding over the surface of a curved die, the variational principle in terms of velocities previously presented by Hill had to be generalized somewhat. Also, in order for the calculation to encompass steady-state extrusion, special care in the selection of finite element geometry had to be exercised to prevent the constraint of virtually incompressible deformation from invalidating the power of the variational principle to generate the solution following significant plastic flow. The elastic-plastic solution of a sheet extrusion problem in plane strain has been evaluated. Employing an initially unstressed material, the computation was continued until sufficient material was extruded so that the steady-state extrusion process had fully developed.

54806 (INIS-mf—4543, pp vp) **Nonlinear aspects of structural fatigue damage assessment and accumulation.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The present paper reviews a recently developed concept for structural fatigue analysis which is capable of accounting for nonlinearities in both the above noted transformations. It is shown that, for cases where the local stressing and straining is proportional, the multiplicity of initiation sites and mechanisms observed to dominate structural fatigue resistance can be explained in terms of these additional nonlinearities. The ability of current concepts for structural fatigue analysis which account for nonlinear action to handle situaions where nonproportional stressing occurs in fatigue critical locations is next examined. Limitations in the assumptions made in fatigue analysis are shown to essentially preclude the application of present technology to that class of problems. A new approach whereby the present fatigue analysis procedures based on a deformation-type plasticity analysis can be extended to handle the nonproportional cycling by their application on a 'memory event' by 'memory event' basis is postulated and discussed in the context of a simple component.

54807 (INIS-mf—4543, pp vp) **Creep-fatigue damage under multiaxial conditions.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Because of the overly conservative nature of linear damage summation, a competitor has emerged -called strainrange partitioning. This procedure is based upon the visualization of the cyclic strain in a uniaxial creep-fatigue test as a hysteresis loop. The associated strainrange is partitioned into the following sub-strainranges: tensile creep strain balanced by compressive creep strain,

tensile plastic strain balanced by compressive plastic strain, and either tensile plastic strain balanced by compressive creep strain, or tensile creep strain balanced by compressive plastic strain. Damage is then assessed by accumulating that resulting from each of the subsstrainranges based on uniaxial failure data for the appropriate type of strainrange. To test these two theories in the most general way, data from experiments involving multiaxial stresses and non-proportional loading is required. As such data is not yet available, an analytical comparison has been developed here with its primary focus on the application of both theories to a set of verified multiaxial finite element calculations. The physical configuration for which these calculations are made is a thermal pipe-ratchetting experiment conducted at ORNL. In this experiment the pipe segment is subjected to cyclic loadings resulting from pressure and thermal histories imposed on the liquid sodium flowing internally. Good correlation has been obtained between the experimental and analytical results. Damage computations by linear damage summation were easily carried out following the rules set down in the ASME Boiler and Pressure Vessel Code. However, for strainrange partitioning, the uniaxial theory had to be extended to handle multiaxiality and non-proportional loading.

54808 (INIS-mf—4543, pp vp) **Application of fracture mechanics to predict service life of dissimilar metal welded pipe joint.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54809 (INIS-mf—4543, pp vp) **Structural analysis of pressure vessels concentration zones at elevated temperatures.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54810 (INIS-mf—4543, pp vp) **Evaluation of state determination calculations in nonlinear analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The nonlinear stress analysis problem involves three major phases, namely (1) linearization, (2) equation solution, and (3) state determination. The evaluation of tangent stiffness relations for the structure constitutes the linearization phase; the solution of a set of linear equations to determine a displacement increment constitutes the equation solution phase; and computation of the corresponding increments of stress and strain to obtain a new state is the state determination phase. The linearization and equation solution phases have received wide coverage in the literature. The intention of this paper is to study the state determination computations. Materials may be classified as elastic, hyperelastic or hypoelastic. Elastic and hyperelastic materials are relatively easy to consider, because their constitutive relationships can be derived from conditions of uniqueness and reversibiliy, and there is a one-to-one correspondence between stress and strain. Hypoelastic materials are more complex because the state of stress also depends on the history of deformation. For the often-occurring elasto-plastic materials, with either isotropic or kinematic hardening, the hardening rule can be specified by a loading function, such that any stress state enclosed by the current function is elastic, whereas any stress state on or beyond the function in plastic. Two important cases need to be considered in the state determination for these models, namely (a) the transitional case, in which the current state is elastic and the new state is plastic, and (b) the plastic loading case, in which both the states are plastic.

54811 (INIS-mf—4543, pp vp) **Mode approach to rational synthesis of structures under impulsive and dynamic pressure loading.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The aim of this work is to study optimal synthesis of beams and plates which are subjected to initial impulses of given kinetic energy or dynamic pressure loading. Such form of a structure is to be determined for which mean or local final deflections are minimized for given material volume and prescribed kinetic energy of the initial impulse. Starting from mode approximation, it was shown that maximization of the eigenvalue of mode solution leads to minimization of the mean deflection and the problem of maximizing this eigenvalue can be used as a major criterion in generating optimal design solutions. On the other hand, for minimization of a local final deflection, the numerical search technique must be applied. In particular, it was shown that for perfectly plastic structures the static criteria of optimal design based on a concept of a simultaneous failure mode are not directly applicable in the case of dynamic loading and the significance of one-degree-of-freedom modes was demonstrated. In the case of dynamic pressure loading, the piecewise mode solutions were applied in the range of moderate pressures in order to determine optimal designs. A direct variational approach or optimal control theory are useful tools in deriving optimality conditions and relative numerical methods. Examples of beams and circular plates are considered in detail in order to illustrate general results reached in the first part of work. Designs with continuously varying and piecewise constant cross sections were considered and their effectiveness with respect to uniform designs was studied.

54812 (INIS-mf—4543, pp vp) **Overview of the basic progress in ductile fracture.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This lecture focuses on an overall review of the physics and mechanics of ductility and ductile fracture of two-phase alloys. Experimentally observed ductile fracture processes are examined first. In the absence of void-nucleating non-metallic second-phase small particles, a single crystal of some metals within a suitable temperature range may be drawn to a chisel point in a tensile test. A similar phenomenon can be produced in some polycrystalline metals under hyrostatic pressure which retards the formation and growth of microvoids at second-phase non-metallic particles. Hence, it is believed that ductility is highly affected by the presence of void-nucleating particles. Voids are usually nucleated by either the cracking of particles (weak, brittle particles) or by the decohesion of the particle matrix interface (for strong particles), so that ductility increases of the particle strength and the interfacial bond are increased. Moreover, voids are first nucleated at larger particles, and therefore ductility tends to increase with decreasing particle size and volume fraction of void-nucleating particles. Analytical and numerical methods used to analyze the above-mentioned processes are discussed next. Early work in this connection considers noninteracting voids of special geometry. Nevertheless, it has been demonstrated analytically that the stress triaxiality may influence ductility to a large extent. Such a state occurs naturally in front of a blunted microcrack in metals, in a necked tensile test bar, or immediately upon loading in notched tensile test bar. Recently, several attempts have been made to include the void-interaction effects by numerical analysis.

54813 (INIS-mf—4543, pp vp) **Effects of irradiation on thermomechanical behavior of inelastic materials.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The objective of the paper is to give a critical review of phenomenological descriptions of thermomechanical behavior of irradiated, inelastic materials. In the first part an analysis of neutron irradiation effects is presented. This analysis is based on available experimental results for inelastic materials. Particular attention is also given to the discussion of the mechanisms reponsible for internal dissipation of an irradiated material. It has been shown that the thermal activation process and the damping of dislocation motion by phonon viscosity and phonon scattering are the most important mechanisms for proper explanation of the strain rate sensitivity and temperature effects. On the basis of these dissipative mechanisms the irradiation effects are explained and simple models are proposed. These models are used in the second part of the paper to formulate reasonable phenomenological theories of thermoinelasticity of irradiated materials. These theories are constructed within the framework of an internal state variable description. A physical interpretation of internal state variables introduced is given and the evolution equations for them are postulated. The third part of the paper is devoted to the explanation of fracture phenomena in irradiated metals. This consideration is based on physical analysis of fracture mechanisms and on available experimental data. Particular examples of fracture criteria are given. Influences of temperature, irradiation effects and strain rate effects on fracture phenomenon are discussed.

54814 (INIS-mf—4543, pp vp) **New developments concerning the two-surfaces theory of plasticity and viscoplasticity.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The classical theories of plasticity and viscoplasticity are based on the assumption that there exists a yield surface in stress space. Phillips and Sierakowski, Acta Mechanica 1(1965)29, proposed the concept that there exist simultaneously a yield surface and a loading surface. Thus, the concept of a two surface theory of plasticity and viscoplasticity was initiated. This concept was further elaborated by Eisenberg and Phillips, Acta Mechanica 11(1968)247, and it was used by Dafalias and Popov as well as by Krieg. Until recently there was a complete lack of experimental verification of the existence of a loading surface distinct from the yield surface. Recently, Phillips as well as Phillips and Moon have shown by experiments on pure aluminum that a loading surface distinct from the yield surface exists. The concept of the loading surface and its relation to the yield surface was explored up to now only for one temperature, that is, in the six-dimensional stress space and not in the seven-dimensional stress-temperature space. In the present paper we introduce the concept of the loading surface as well as that of the yield surface for a set of temperatures in the stress-temperature space. We give experimental verification of the existence of the loading surface for a set of temperatures for pure aluminum, as well as for copper. On the basis of a large number of experiments we discuss, for a set of temperatures, the relation between the yield

surface and the loading surface and the development of the plastic strains and creep strains.

54815 (INIS-mf—4543, pp vp) **Global plastic models for computerized structural analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In many types of structures, it is possible to use generalized stresses (like membrane forces, bending moment, torsion moment...) to define a yield surface for a part of the structure. Analysis can be achieved by using the HILL's principle and a hardening rule. The whole formulation is said 'Global Plastic Model'. Two different global models are used in the CEASEMT system for structural analysis, one for shell analysis and the other for piping analysis (in plastic or creep field). In shell analysis the generalized stresses chosen are the membrane forces and bending (including torsion) moments. There is only one yield condition for a normal to the middle surface and no integration along the thickness is required. In piping analysis, the choice of generalized stresses is bending moments, torsional moment, hoop stress and tension stress. There is only a set of stresses for a cross section and no integration over the cross section area is needed. Connected strains are axis curvature, torsion, uniform strains. The definition of the yield surface is the most important item. A practical way is to use a diagonal quadratic function of the stress components. But the coefficients are depending of the shape of the pipe element, especially for curved segments. Indications will be given on the yield functions used. Some examples of applications in structural analysis are added to the text.

54816 (INIS-mf—4543, pp vp) **Background to the elastic creep-fatigue rules of the ASME B and PV code case 1592.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54817 (INIS-mf—4543, pp vp) **Design of mild steel structures under unequal cyclic loads.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this paper a method is proposed to investigate the behavior and life of structural components under unequal cyclic loading conditions. Appropriate cyclic moment-curvature relations and life information, in the form of life versus extreme fiber strain, are developed from tests on beams under pure bending conditions. Theoretical predictions of behavior are based on structural geometry and the cyclic moment-curvature relations used in association with the simple curvature-area method. Structural life is also predicted using the life information developed and the theoretical strain history at the critical section in conjunction with a linear damage summation criterion. Theoretical predictions of behavior and life compare reasonably well with the experiments. Based on this study, a design procedure is proposed for mild steel components subjected to unequal cyclic loading conditions. The loads on the tested components were such that they failed due to low cyclic fatigue (i.e., at less than 10^5 cycles).

54818 (INIS-mf—4543, pp vp) **Stable computational scheme for stiff time-dependent constitutive equations.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Viscoplasticity and creep type constitutive equations are increasingly being employed in finite element codes for evaluating the deformation of high temperature structural members. These constitutive equations frequently exhibit stiff regimes which makes an analytical assessment of the structure very costly. A computational scheme for handling deformation in stiff regimes is proposed in this paper. By the finite element discretization, the governing partial differential equations in the spatial (x) and time (t) variables are reduced to a system of nonlinear ordinary differential equations in the independent variable t. The constitutive equations are expanded in a Taylor's series about selected values of t. The resulting system of differential equations are then integrated by an implicit scheme which employs a predictor technique to initiate the Newton-Raphson procedure. To examine the stability and accuracy of the computational scheme, a series of calculations were carried out for uniaxial specimens and thick wall tubes subjected to mechanical and thermal loading. Simulation runs based on a power law creep relationship demonstrated that the stability and accuracy of the above scheme is substantially better than those associated with the initial strain approach. The computed results are also in excellent agreement with published results. Analytical studies based on the MATMOD constitutive equations, which is specifically developed for Zircaloy, are also reported.

54819 (INIS-mf—4543, pp vp) **Some recent developments in the endochronic theory of plasticity - The concept of internal barriers.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In 1971 we proposed the endochronic theory of plasticity. We subsequently demonstrated that the theory can predict complex aspects of plastic material response without recourse to the existence of a yield surface. We further showed that the rate independent form of the endochronic theory of nonelastic behavior does not rely for its development on precepts of plastic strain and constitutive constraints such as the normality of plastic strain relative to the yield surface, but is based on the thermodynamic theory of internal variables. This we regarded as a step forward because of the extensive experimental difficulties associated with the determination of the geometric configuration of the yield surface, and the evolution of such a configuration with the history of stress. For an extensive discussion of these difficulties the reader is referred to previous references. It will be shown in this paper that yield can be encompassed by the endochronic theory, in a fashion which is more akin, yet basically and fundamentally different, to Mroz's concept of multiple yield surfaces, whose mode of motion must be specified. Moreover, a single yield event is replaced by a sequence of yield events, where such a sequence may be made continuous, in a limiting sense, if so desired. In this paper the analytical representation of successive yielding events is accomplished by the introduction of the concept of INTERNAL BARRIERS. These ensure that an internal variable qsub(r) will not become activated until a barrier of magnitude u has been overcome. The resulting theory is shown to describe with remarkable accuracy loading, unloading and cross behavior of common metals.

54820 (INIS-mf—4543, pp vp) **Finite-difference simulation of a multi-pass pipe weld.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

An analytical technique to study the thermomechanical response of pipes during welding and subsequent to welding is presented. The numerical simulation was performed using STEALTH, a two-dimensional explicit-finite difference code. A finite difference grid was designed to represent the weld region and a portion of a long, 4-in. diameter butt-welded pipe. The thermal and temperature-dependent mechanical properties of Type 304 stainless steel were used bor both the pipe and the weldment materials. The welding area was subdivided into seven regions. The model for spatial and temporal heat deposition was compatible with the welding speed and conditions reported in relevant G.E. Reports. Since creep is not included, the residual stresses after cooling depend only on the stress-strain path and not on the total time inolved. Therefore, the excess heat in the grid at late times could be withdrawn artificially. This was done by a prescription that smoothly reduced the temperature gradients to achieve ambient conditions. Because the thermal and mechanical responses were computed simultaneously, it was desirable to reduce the disparity between the associated thermal time step and the mechanical time step (based on sound speed). This was achieved by increasing the mechanical time step by employing a density scaling factor of 7.58×10^{11} to make the two time steps similar. A dynamic relaxation technique was then used to damp the nonphysical mechanical oscillations that were generated by the thermal expansions and contractions.

54821 (INIS-mf—4543, pp vp) **Numerical analysis of circular elastic-plastic plates under cycles of pressure and temperature.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54822 (INIS-mf—4543, pp vp) **Three-dimensional inelastic finite element analysis of a solid Y-type cylinder intersection.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54823 (INIS-mf—4543, pp vp) **Dynamic expansion and fracture of stainless steel cylindrical shells.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Cylindrical shells of stainless steel were expanded at strain rates between 10^2 and $10^4\ s^{-1}$ in order to determine fracture strength at high strain rates. The shells were expanded with magnetic pressure pulses from a capacitor discharge and the simultaneous detonation of high explosives with a mesh of copper bridgewires. Response of the cylinders was monitored with a high speed framing camera and pulsed x-rays. The fracture strength of 301, 304 and Armco Nitronic 33 stainless steel cylinders was determined by expanding a series of each material at high rates of strain with magnetic pressure pulses. All cylinders had a length of 3.0 in. and thickness 0.02 in.; the outer diameter for the 301 and 304 materials was 5.5 in. and the outer diameter for the Nitronic 33 material was 6.5 in. Axial lines were drawn on the outside surface of the cylinders and were initially 1.0 in. apart. Expansion strains and strain rates were obtained from photographs taken with a Cordin Model 114 framing camera by measuring the frame by frame elongation between the lines on the surface of the cylinder. Initial strain rates are proportional to the initial radial wall velocities which were always nearly constant and compared closely with that calculated from the integration of the

magnetic pressure over time. Final strains are plotted versus initial strain rates and the initial strain rate required to produce fracture is bracketed. For these cylinder geometries the cylinders reached 35, 23 and 19 percent strain prior to fracture for the 301, 304 and Nitronic 33 materials, respectively.

54824 (INIS-mf—4543, pp vp) **Computational techniques for inelastic analysis and numerical experiments.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A number of formulations have been proposed for inelastic analysis, particularly for the thermal elastic-plastic creep analysis of nuclear reactor components. In the elastic-plastic regime, which principally concerns with the time independent behavior, the numerical techniques based on the finite element method have been well exploited and computations have become a routine work. However, the establishment of the constitutive relations is still an important task. Therefore, a computer program should be designed and developed with sufficient generality so that it allows for the novel constitutive equations which may be proposed from the side of material scientists interested in the micro-mechanisms of plastic deformation. With respect to the problems in which the time dependent behavior is significant, it is desirable to incorporate a procedure which is workable on the mechanical model formulation as well as the method of equation of state proposed so far. A computer program should also take into account the strain-dependent and/or time-dependent micro-structural changes which often occur during the operation of structural components at the increasingly high temperature for a long period of time. The present paper introduces a rational updated formulation and a computer program under development by taking account of the various requisites stated above. Numerical examples include 1) thermal elastic-plastic creep deformation of a thick walled cylinder, 2) numerical experiments on the tensile instability of uniaxial test specimens and 3) typical examples from the activities of JSME (Japan Society of Mechanical Engineering) Committee on Research and Development of Inelastic Analysis Programs.

54825 (INIS-mf—4638, pp vp) **Influence of axial flow on vibration behavior of finite cylindrical shells.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A computational method is described for calculating the free vibrations of thin finite cyclindrical shells with a surrounding fluid gap. The surrounding fluid may have an axial steady velocity. The method can be used as an aid in vibration analysis of thin-walled cylindrical parts of reactor core and coolant circuit structures. The influence of all types of so-called regular boundary conditions for the shell is taken into account, thus allowing for all possible combinations of clamped, simply supported, fixed supported, relaxed simple supported and free edges. For an originally motionless fluid a simplified method has previously been proposed by one of the authors SMiRT-3, Paper F8/4), using only the first term in the series solution for the radial displacement amplitude of the shell. It was pointed out that sometimes numerical difficulties could occur and resulted from negative added fluid masses. In order to avoid these difficulties a revised fluid-shell model is introduced in the present paper in which a rigid cylinder with the same radius as the outer radius of the cylindrical shell is added to each side of the cylindrical shell. Next, a series of travelling waves with different wave lengths in the axial direction is created, the sum of which satisfies the desired boundary conditions for the cylindrical shell and the condition of zero displaacement for the rigid cylinders. For an originally motionless fluid, the influence of the coupling effect between the different beam functions is analysed numerically and a comparison is given with experimental evidence. For a fluid with an axial steady velocity, the above computational method is applied to the clamped-clamped and the clamped-free shells.

54826 (INIS-mf—4638, pp vp) **Fluid-structure interaction calculations.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54827 (INIS-mf—4638, pp vp) **Transient cavitation effects in fluid piping systems.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54828 (INIS-mf—4638, pp vp) **Hydrodynamic impact of reactor components. A review.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A variety of components belonging to a nuclear reactor are by virtue of their design exposed to a mass of fluid which is either in motion or can be set into motion under certain conditions. While the reactor is in its operational mode, the excitations of the structure by the fluid are generally of moderate intensities. In the case of a well designed component, these pressure fluctuations should not cause the failure of the structure. Problems of this type, generally known as vibrations of structures immersed into fluid (under either periodic or random excitations) has been studied in the past rather extensively. In an upset or emergency condition, a pressure pulse is usually generated and propagated through the fluid. While this hypothetical event is an occurrence of low probability, the associated pressures are, as a rule, of intensities sufficiently large to cause extensive damage or even the failure of the component. This type of transient interaction problem is much less studied and the aim of this review is to offer a brief discussion of some of the more interesting results.

54829 (INIS-mf—4638, pp vp) **Dynamic analysis of structures with solid-fluid interaction.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This study develops a finite element model for interaction between an elastic solid and fluid medium (flow-induced vibrations in nuclear reactor components). Plane triangular finite elements have been used separately for fluid, solid, and solid-fluid continuua and the equivalent mass, damping, and stiffness matrices and interaction load arrays for all elements are derived and assembled into global matrices. The global matrix differential equation of motion developed is solved in time to obtain the pressure and velocity distributions in the fluid, as well as the displacements in the solid. Two independent computer programs are used to obtain the dynamic solution. The first program is a finite element program developed for solid-fluid interaction studies. This program uses the modal superposition technique in which the eigenvalues and eigenvectors for the system are found and used to uncouple the equations. This approach allows an analytic solution in each integration time step. The second program is WECAN finite element program in which a new element library subroutine for solid-fluid interaction was incorporated. This program can employ a NASTRAN direct integration scheme based on a central difference formula for the acceleration and velocity terms and an implicit representation of the displacement term. This reduces the problem to a matrix equation whose right hand side is updated in every time step and is solved by a variation of the Gaussian elimination method known as the wave front technique Results have been obtained for the case of water, between two flat elastic parallel plates, initially at rest and accelerated suddenly by applying a step pressure. The results obtained from the above-mentioned two independent finite element programs are in full agreement. This verification provides the confidence needed to initiate parametric studies. Both rigid wall (no solid-fluid interaction) and flexible wall (including solid-fluid interaction) cases were examined.

54830 (INIS-mf—4638, pp vp) **Efficient formulation of the finite element method for heat conduction in solids.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of the paper is to describe efficient methods and computer programs for analysis of heat conduction problems related to design and control of components of nuclear power plants and similar structures where thermal problems are of interest. A short presentation of basic equations and the finite element formulation of three-dimensional stationary and transient heat conduction is given. The finite element types that are used are isoparametric hexahedrons with eight or twenty nodes. The use of consistent as well as diagonal capacity matrices is discussed. Reduction of the transient heat conduction problem may be accomplished by means of the 'master-slave' technique. Furthermore, the superelement technique is discussed for both stationary and transient heat conduction. For the solution of transient problems, the trapezoidal time integration scheme is used. The methods and principles outlined in the paper are materialized in a computer program, NV615, which is one of the application programs in the program system SESAM-69. A brief description is given of NV615. Furthermore, attention is given to combined heat conduction and subsequent thermal stress analysis. Data representing geometry, calculated temperature distribution etc may be transferred automatically from the heat conduction program to stress analysis programs. As an example of practical application the temperature distribution versus time in a turbine wheel during start up is analysed. Thermal stresses are calculated at selected time instants.

54831 (INIS-mf—4638, pp vp) **Local response of elastic tubes and shells to spherical pressure pulse loading.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper develops a formulation and numerical solution technique for calculating the peak transient stresses developed in tubes or shells with external and internal acoustic media, as a result of shock loadings which may be represented as originating from external or internal point symmetric or dipole sources. The field of application is intended to be the local peak response of the cylindrical fuel cans, core barrels, pressure vessels, pipes and containment shells of Nuclear Reactor Technology, subjected to transient pressure shock loadings for a variety of operational or accident condi-

tions, which cannot adequately be described as one dimensional plane shocks, for which elastic shell responses have been presented by other workers. The work reported here concerns the basic problem of an infinite static fluid filled hollow cylinder of arbitrary thickness, in an infinite static fluid medium, with a source at an arbitrary internal or external radial location. An acoustic model is used, with acoustic damping due to radiation as the only possible damping mechanism. The formulation and solution technique is based on the availability of the multi-dimensional Fast Fourier Transform algorithm. The basic result is the representation, in cylindrical co-ordinates, of the two dimensional (time and axial co-ordinate) Fourier Transform of the infinite medium frequency response function for outgoing waves from a point symmetrical source, as a series of azimuthal Fourier harmonics, from which the result for a dipole source of arbitrary orientation follows. Where possible numerical results will be presented.

54832 (INIS-mf—4638, pp vp) **Experimental investigation on the behavior of pressure suppression containment systems by the SOPRE-1 facility.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The SOPRE-1 test facility is an integral model (scale 1:13) of a MARK II pressure suppression containment system. It was set up at the University of Pisa in order to study the pressure-temperature transient in pressure suppression containment systems during LOCAs. Knowledge of this transient is necessary to perform a correct structural analysis of reactor containment. The containment system behavior is studied by changing the principal parameters which affect the transient (blow-down mass and energy release, suppression pool water temperature, vent pipe number and submergence, heat transfer coefficients). The first series of tests involved: A) 13 tests with break area of 1.8 cm^2, B) 8 tests with break area of 20.0 cm^2. The following experimental conditions were changed: position of the simulated break (from liquid or steam zone), water pressure (20-85 Kg/cm^2) and mass (45-70 Kg) in the vessel model. Tests A): the CONTEMPT codes correctly forecast the pressure-temperature history, both in dry- and in wet-well. Tests B): the experimental runs have shown that increasing of blow-down flow-rate produces dry-well pressure spatial differences and anomalous vent pipe behavior. This results in damped oscillations of dry- and wet-well pressure, probably due to alternating air bubble over-expansion and collapse, and in vent pipe opening and reclosing. Dry-well pressure maxima at the end of blow-down are greater than those forecasted by currently applied codes: these codes use an homogeneous model, and do not take into account the above mentioned dynamic phenomena. In some tests other interesting phenomena were observed, such as some local pressure peaks in the suppression pool greater than dry-well pessure maxima at the end of blow-down. At present, all these phenomena are under study; they could be important for the structural analysis of containment systems.

54833 (INIS-mf—4639) **In situ measurement of dynamic characteristics of atomic power plant equipment.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

For the realistic assessment of stiffness and damping, full scale free vibration tests have been carried out on various pieces of equipment located in plant buildings both during the construction stage and after they are erected. Initial displacement or initial velocity was used to excite the free vibrations. Initial displacement was imparted by means of steel rope pulled with chain pulley block. The sudden release was achieved by means of a clutch system. Acceleration transducer with amplifier and ink writting oscillograph was used for recording the vibrations. Frequency and damping was evaluated from the acceleration records. Observed values for some equipment are given. For some equipment, it has been possible to obtain the values with and without pipe connections. The frequency of L.P. Heater in longitudinal and transverse directions without pipe connection were 17.86 and 10.04 Hz but with pipe connections the values increased to 26.74 and 17.85 Hz. Similarly there has been increase in the damping values too. Thus both the frequency and damping increases substantially with the addition of pipe connections. Moreover, their values are quite different in the two principal directions, pointing out to the importance of in situ measurements on prototype equipment.

54834 (LA-UR—79-978) **Multiple microprocessor based nuclear reactor power monitor.** Lewis, P.S.; Ethridge, C.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-790929—1). Dep. NTIS, PC A02/MF A01.

From 18. IEEE Computer Society international conference; Washington, DC, USA (4 Sep 1979).

The reactor power monitor is a portable multiple-microprocessor controlled data acquisition device being built for the International Atomic Energy Association. Its function is to measure and record the hourly integrated operating thermal power level of a nuclear reactor for the purpose of detecting unannounced plutonium production. The monitor consists of a ^3He proportional neutron detector, a write-only cassette tape drive and control electronics based on two INTEL 8748 microprocessors. The reactor power monitor operates from house power supplied by the plant operator, but has eight hours of battery backup to cover power interruptions. Both the hourly power levels and any line power interruptions are recorded on tape and in memory. Intermediate dumps from the memory to a data terminal or strip chart recorder can be performed without interrupting data collection.

54835 (N—79-14412) **Study on prestressed concrete reactor vessel structures. II-5: Crack analysis by three dimensional finite elements method of 1/20 multicavity type PCRV subjected to internal pressure.** Translated from *Obayashi-Gumi Gijutsu Kenkyusho-Ho;* No. 12, 8-12(Feb 1976). 11p. NTIS PC A02/MF A01.

A three-dimensional finite elements analysis is reported of the nonlinear behavior of PCRV subjected to internal pressure by comparing calculated results with test results. As the first stage, an analysis considering the nonlinearity of cracking in concrete was attempted. As a result, it is found possible to make an analysis up to three times the design pressure (50 kg/sqcm), and calculated results agree well with test results.

54836 (NUREG/CR—0948) **Nonlinear structural dynamic analysis procedures for category I structures.** (Blume (John A.) and Associates, Engineers, San Francisco, CA (USA)). Jul 1979. 293p. NTIS.

This report presents the results of studies conducted to identify and recommend a simplified dynamic analysis procedure applicable for performing nonlinear analyses of Category I nuclear power plant structures. For the recommended simplified procedures, the theoretical background, mathematical formulation, analytical solution, verification of reliability, and interpretation of results were established. In addition, studies were conducted to compare the results of conventional linear analysis with nonlinear analyses to establish the relative merits of the two approaches.

54837 (NUREG/CR—0966) **Simplified damage assessment of nuclear power plants subjected to turbine fragments.** Biehl, F.; Smith, P.D. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 46p. (LA—7944-MS). Dep. NTIS, PC A03/MF A01.

An analytical method and associated computer program are described by which the probability of damaging critical components of a nuclear power station can be determined. Input information consists of parameters that define the turbine, barriers, and targets. Barriers are noncritical objects that impede the flight of fragments from the turbine to the target. Targets can be plant structures, systems, and components. The program produces a matrix that relates the probability of damaging each target to each turbine wheel individually, as well as to the aggregate of all turbine wheels in the plant. In addition, the probability of either striking or penetrating selected barriers can be obtained. Results of an example calculation are presented.

54838 (RDT-M—2-5T(8-79)) **Austenitic stainless steel welding fittings (ASME SA-403 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 14p. RSO.

This standard covers austenitic stainless steel welding fittings for nuclear and associated applications. Material shall conform to the requirements of ASME SA-403; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

54839 (RDT-M—3-4T(8-79)) **Nickel alloy seamless tubes (ASME SB-163 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 9p. RSO.

This standard covers nickel alloy seamless tubes for nuclear and associated applications. Material shall conform to the requirements of ASME SB-163; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

54840 (RDT-M—6-3T(7-79)) **Alloy steel bolting material for high-temperature service (ASME SA-193 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 13p. RSO.

The standard for alloy steel bolting material (bar, bolts, screws, studs, and stud bolts) for high temperature service in nuclear applications is presented.

54841 (RDT-M—6-4T(7-79)) **Alloy steel nuts for bolting for high-pressure and high-temperature service (ASME SA-194 with additional requirements).** (Department of Energy, Washington, DC

(USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 9p. RSO.

This standard covers alloy steel nuts for bolting for high-pressure and high-temperature service in nuclear and associated applications.

54842 (RDT-M—1-3T(8-79)(Rev.)) **Mild steel covered welding electrodes (ASME SFA-5.1 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 8p. RSO.

This standard covers mild steel covered welding electrodes for nuclear and associated applications. Material shall conform to the requirements of ASME SFA-5.1; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

54843 (RDT-M—2-12T(8-79)(Rev.)) **Nickel-molybdenum-chromium alloy welding fittings (ASME SA-403 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 11p. RSO.

This standard covers nickel-molybdenum-chromium alloy welding fittings for nuclear and associated application. Fittings shall conform to the requirements of Code Case 1345 and the applicable requirements of ASME SA-403; to the applicable requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000, as further defined herein; and to the additional requirements of this standard.

54844 (RDT-M—6-6T(7-79)(Rev.)) **High-strength, high-temperature bolting materials (ASME SA-453 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 11p. RSO.

This standrad covers high-strength, high-temperature bolting material (bars, bolts, screws, studs, and stud bolts) for nuclear and associated applications. Material shall conform to the requirements of ASME SA-453; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; to the requirements of RDT E 8-18 for finished products; and to the additional requirements of this standard.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 55190, 55274, 55289

54845 (CONF-791103—8(Summ)) **Automated ultrasonic scanning of flat plate nuclear fuel.** Barna, B.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Flat plate nuclear fuel is subject to at least two fabrication induced flaws which lend themselves to ultrasonic detection. This paper describes a production inspection system designed at the INEL that combines separate ultrasonic immersion techniques to detect thin cladding and bonding of fuel to cladding. Clad thickness refers to the amount of aluminum cladding remaining over the fuel after hot rolling, while bonding refers to the quality of bond between the fuel and its aluminum matrix or cladding. The cladding thickness measurement uses a unique 50 MHz transducer operating in pulse-echo mode to detect interfaces as close together as 0.15 mm in aluminum. The transducer is held to within +- 0.1 mm of a given position during high speed scanning by an electro-mechanical servo. The bonding measurement uses two transducers in a thru transmission configuration. A lack of bonding causes a significant loss of signal which is recognized as a flaw. The entire system is configured for maximum through-put on the production line.

54846 (FEI—781) **Experimental study on temperature fields at the inlet section of rod bundles flow-arrounded by turbulent flow of liquid metal coolent. In simultaneous hydrodynamic and thermal stabilization.** Zhukov, A.V.; Matyukhin, N.M.; Kotovskii, N.A.; Sviridenko, E.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1977. 15p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

The experimental study on temperature fields is carried out at the inlet thermal section of rod bundles flow-arrounded by a turbulent flow of a liquid metal coolant (a sodium-potassium alloy) in simultaneous hydrodynamic and thermal stabilization. The heat transfer along the height of the rods was constant. The relative rod pitch ($1.0 < s/d < 1.42$), the parameter of the equivalent rod thermal conductivity ($0.4 <$ epsilon < 15) and the Peckle (Reynolds) number where changed. The empirical relations for calculating the lengths of the inlet thermal sections according to the coefficients of heat transfer and the temperature non-uniformity are obtained. Experimentally shown is the possibility of using the Duamel integral for hydrodynamically nonstabilized flow at the inlet section of rod lattices in case of cosinusoidal heat extraction characteristic for fast reactors. The factual material is obtained according to the coefficients of heat transfer and the temperature non-uniformity at the inlet thermal section of the rod bundles for the direct utilization in calculating for the alternating energy extraction according to the Duamel relation.

54847 (INIS-mf—4638, pp vp) **Flow-induced instabilities of clusters of flexible cylinders in axial flow contained in a cylindrical channel.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper describes a theoretical study of the dynamics of clusters of flexible cylinders in axial flow bounded by a cylindrical rigid pipe, (liquid-cooled fuel element bundles in pressure tubes). Both inviscid and viscous coupling in the motions of the cylinders is taken into account, as well as the effect of proximity to the surrounding channel. The inviscid hydrodynamic forces were determined by slender body theory, obtaining the velocity potential at any axial cross-section of the system due to arbitrary small motions of the cylinders. A virtual mass matrix was obtained, associated with a displacement vector whose components are the lateral displacements associated with each cylinder in mutually perpendicular directions. The magnitude of the off-diagonal terms indicated strong coupiing in the motions of cylinders, which increases with diminishing spacing between cylinders. Viscous coupling was taken into account by considering that motions of adjacent cylinders perturb the ordinarily undisturbed axial flow. A viscous force matrix was obtained, and it was found that viscous coupling can be important. The resulting coupled equations of motions (2k equations for a system of k cylinders) were solved to yield the eigenfrequencies and modal shapes of the system. The eigenfrequencies were found to occur in groups of 2k 'first modes', 2k 'second modes', etc. With increasing flow velocity the system behaves qualitatively as would a single cylinder in unbounded flow; thus, for sufficiently high flow velocities, buckling and flutter instabilities are obtained. Quantitatively, however, the critical flow velocities are two or three times less than for a single cylinder in unbounded flow.

54848 (LA-UR—79-2128) **PINEX-2: pinhole-TV imaging of fuel ejection from an internally vented capsule.** Berzins, G.J.; Lumpkin, A.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-790816—49). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The LASL pinhole-intensified TV system was used at the TREAT reactor to image an internally vented, fuel-ejection capsule designed and built by HEDL. Several improvements in the imaging system over PINEX-1 were incorporated. A sequence of 16-ms TV frames shows axial expansion, expulsion of fuel from the pin, and retention of clad integrity during the time of coverage.

CONTROL SYSTEMS

REFER ALSO TO CITATION(S) 54956

54849 (INIS-mf—4244) **Effect of regulatory requirements on the control and instrumentation system designer.** Golder, J.A. (UKAEA, Risley. Nuclear Power Development Establishment). 1978. 3p. (CONF-7710184—20). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA specialists meeting on the effect of regulatory requirements on nuclear power plant control and instrumentation systems; Madrid, Spain (4 Oct 1977).

The difficulties encountered by the designer of control and protection systems for nuclear plant in attempting to satisfy the large number of imprecise regulations and recommendations which exist are described. The absence of fundamental quantitative safety requirements of international acceptability is deplored and the adoption of a major incident criteria expressed in quantitative terms as the basis for the derivation of target design criteria for protection systems and plant components is suggested.

54850 (INIS-mf—4878, pp 15-95) **Radiation control system of nuclear power plants.** Kapisovsky, V.; Kosa, M.; Melichar, Z.; Moravek, J.; Jancik, O. (Vyskumny Ustav Energeticky, Jaslovske Bohunice (Czechoslovakia)). 1977. (In Slovak).

From 2. conference on modular systems for data acquisition and processing; Prague, Czechoslovakia (8 Nov 1977).

The SYRAK system is being developed for in-service radiation control of the V-1 nuclear power plant. Its basic components are an EC 1010 computer, a CAMAC system and communication means. The in-service release of radionuclides is measured by fuel can failure detection, by monitoring rare gases in the coolant, by

gamma spectrometric coolant monitoring and by iodine isotopes monitoring in stack disposal.

54851 (INTAT—78-70, pp 84-101) **Design view points and material aspects for SNR absorber.** Duenner, P.; Toebbe, H. Aug 1978. (In German).

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

The present meetings report gives a survey on the state of development for absorbers of fast reactors. Numerous materials, material combinations and geometrical configurations are for neutron-physical reasons possible for the various reactor concepts of control and shutdown. Boron carbide is primarily used as reference material in the SNR, however, numerous alternatives to realize long-term project targets are still being persued.

54852 (INTAT—78-70, pp 28-48) **LWR control elements and burnable absorbers.** Fuchs, H.P. Aug 1978. (In German).

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

The present meetings report gives a survey on the state of development of absorbers of light-water reactors. Numerous materials, material combinations and geometrical configurations are for neutron-physical reasons possible for the various reactor concepts for control and shutdown. The technology is essentially established for LWRs, boron carbide and Ag-In-Cd have proved themselves as absorber material. The improvements are in the lines of cost reduction and disposal.

54853 (INTAT—78-70, pp 70-83) **HTR-torque rod.** Haas, H.; Fleischer, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie); Hammelmann, K.H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung); Ullrich, M.; Esser, H. (Gesellschaft fuer Hochtemperaturreaktor-Technik m.b.H., Bergisch Gladbach (Germany, F.R.)). Aug 1978. (In German).

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

The function, drive and behaviour of the HTR torque rod are described in the present report, as well as the absorber materials used discussed.

54854 (INTAT—78-70, pp 1-27) **Neutron physics of the absorber.** Henssen, H. Aug 1978. (In German).

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

The present, greatly simplified presentation is to broaden the understanding of the reactor physicists problems in designing absorber rods and to render the solutions taken plausible.

54855 (INTAT—78-70, pp 64-69) **HTR-lifting rods.** Schmitt, H. (Hochtemperatur-Reaktorbau G.m.b.H. (Germany, F.R.)). Aug 1978. (In German).

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

The so-called lifting and torquerods are the mot actual concepts for control, shim and shutdown rods for high-temperature reactors with pebble beds which are mainly being considered within the framework of the present new regulation of the HTR development. Contrary to the pressurized-water and boiling water reactor rods, the core rods of the pebble bed experience essentially new boundary conditions which decisively influence the constructive fabrication forms of rod and drive. In addition to the usual environmental conditions such as coolant, pressure, temperature and radiation in its broadest sense, the rods are also exposed to reaction forces of the pebble bed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 55061

54856 (RAND/N—1188-DOE) **Anticipated transients without scram for light water reactors: implications for liquid metal fast breeder reactors.** Kastenberg, W.E.; Solomon, K.A. (RAND Corp., Santa Monica, CA (USA)). Jul 1979. Contract ET-78-S-03-2243. 40p. Dep. NTIS, PC A03/MF A01.

In the design of light water reactors (LWRs), protection against anticipated transients (e.g., loss of normal electric power and control rod withdrawal) is provided by a highly reliable scram, or shutdown system. If this system should become inoperable, however, the transient could lead to a core meltdown. The Nuclar Regulatory Commission (NRC) has proposed, in NUREG-0460 [1], new requirements (or acceptance criteria) for anticipated transients without scram (ATWS) events and the manner in which they could be considered in the design and safety evaluation of LWRs. This note assesses the potential impact of the proposed LWR-ATWS criteria on the liquid metal fast breeder reactor (LMFBR) safety program as represented by the Clinch River Breeder Reactor Plant.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 55511, 55512

54857 (SAND—79-1325C) **Dispersion parameters: impact on calculated reactor accident consequences.** Aldrich, D.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-791103—12). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Much attention has been given in recent years to the modeling of the atmospheric dispersion of pollutants released from a point source. Numerous recommendations have been made concerning the choice of appropriate dispersion parameters. A series of calculations has been performed to determine the impact of these recommendations on the calculated consequences of large reactor accidents. Results are presented and compared in this paper.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 55505

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 54666, 54708, 54989, 54990, 55013, 55720, 55723

54858 (ANL—79-26) **Fission-product releases to the primary system of EBR-II from April 1975 to March 1977.** So, B.Y.C.; Lambert, J.D.B.; Kirn, F.S.; Armstrong, J.R.; Ebersole, E.R.; Laug, M.T. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 59p. AT.

This report describes the 14 releases of fission products that occurred in EBR-II from April 1975 to March 1977. Each release was readily detected, and all but one (in a driver-fuel subassembly) was identified with a particular subassembly. Xenon tagging was the primary method of identification, although other methods were used where appropriate. Methods of monitoring and identifying fission-product sources are discussed, and each release and identification is described. Effects of breached elements on plant availability were minimal in this period. From all evidence, cladding breaching on elements in EBR-II continues to be a benign process.

54859 (ANL-Trans—1170) **Determination of several parameters in the nuclear reactor IAN-R1.** Sandoval, E.; Ramirez, G.; Barragan, A.; Antonio, M. (Instituto de Asuntos Nucleares, Bogota (Colombia). Div. Reactor). Jun 1979. Translation of IAN-R—1-2, 1967. 25p. Dep. NTIS, PC A02/MF A01.

This study includes, first, a description of the IAN-R1 reactor itself and of its principal characteristics, such as: critical mass excess, geometry, dimensions, safety rods, shielding and control instruments. The study then presents a series of experimental results relating to power calibration and the effect on the critical mass excess of different elements foreign to the reactor. The power calibration experiment also indicates the vertical flux distribution, which is very important in determining the neutron immersion dose that an element foreign to the reactor can receive in a given location. In the experiment labeled Effect on Reactivity of a Neutron Absorber as a Function of its Position in the Core we indicate the effect of that element as a function of flux density and location. Finally, the effect of the core temperature on reactivity is also presented.

54860 (BNL—50847, pp 23-55) **TRISTAN II: extension of capabilities to non-gaseous fission products.** Wohn, F.K. (Iowa State Univ., Ames). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The ISOL facility TRISTAN II is described and its expected capabilities on-line to the High Flux Beam Reactor at Brookhaven National Laboratory are discussed. In particular, the range of isotopes expected to be available and possible experimental studies of the short-lived fission-product isotopes are described. 11 figures, 5 tables.

54861 (CONF-790423—16) **Performance assessment of mass flow rate measurement capability in a large scale transient two-phase flow test system.** Nalezny, C.L.; Chapman, R.L.; Martinell, J.S.; Riordon, R.P.; Solbrig, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 18p. Dep. NTIS, PC A02/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

Mass flow is an important measured variable in the Loss-of-Fluid Test (LOFT) Program. Large uncertainties in mass flow measurements in the LOFT piping during LOFT coolant experiments requires instrument testing in a transient two-phase flow loop that simulates the geometry of the LOFT piping. To satisfy this need, a transient two-phase flow loop has been designed and built. The load cell weighing system, which provides reference mass flow measurements, has been analyzed to assess its capability to provide the measurements. The analysis consisted of first performing a thermal-hydraulic analysis using RELAP4 to compute mass inventory and pressure fluctuations in the system and mass flow rate at the instrument location. RELAP4 output was used as input to a structural analysis code SAPIV which is used to determine load cell response. The computed load cell response was then smoothed and differentiated to compute mass flow rate from the system. Comparison between computed mass flow rate at the instrument location and mass flow rate from the system computed from the load cell output was used to evaluate mass flow measurement capability of the load cell weighing system. Results of the analysis indicate that the load cell weighing system will provide reference mass flows more accurately than the instruments now in LOFT.

54862 (CONF-790923—3(Summ.)) **Conference on decontamination and decommissioning of nuclear facilities.** Meservey, R.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 6 Feb 1979. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

A brief history of Decontamination and Decommissioning (D and D) experience at the Idaho National Engineering Laboratory is presented as an introduction to the status of current projects. Details are then presented as an introduction to the status of current projects. Details are then presented on a project to remove sodium from some major components of the Hallam reactor and on the Organic Moderated Reactor Experiment (OMRE) decommissioning project. Cost, schedule, waste volume, and other technical data from these projects are presented. In addition, a brief summary of the future INEL D and D program is presented.

54863 (CONF-791103—15) **Requalification of the LOFT reactor following a loss of coolant experiment (Level I).** Cannon, J.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

During a Loss of Coolant Experiment (LOCE), the LOFT reactor experiences an acceleration of 10 G's and fuel cladding temperature changes at a rate of 1100 °K/sec. These unparalleled conditions present a unique startup problem to the LOFT program: How can the integrity of the fuel be confirmed so as to minimize operation if damage has occurred. The Level I Requalification Program is designed to accomplish this. It is a progressive series of tests, designed to detect damage at the earliest possible time, and thus preclude or minimize operation if damage exists. First, fuel specialists examine the LOCE data for possible damaging conditions and the results of primary coolant sample analysis for signs of failed fuel. Second, the requalification program proceeds to a series of mechanical and physics tests.

54864 (HEDL—6557) **Nondestructive testing methods and equipment: Section 3.0. Semiannual report to Oak Ridge National Laboratory, October 1978—March 1979. Advance copy.** Michaels, T.E.; Horn, J.E.; Boehmer, W.D.; Trantow, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1979. Contract EY-76-C-14-2170. 15p. Dep. NTIS, PC A02/MF A01.

A system configuration has been determined for scan control, data acquisition, and real-time analysis for ultrasonic inspection of a weld in the secondary loop at FFTF. This system will significantly decrease time requirements for inspection and reduce data storage by utilizing a host computer to coordinate activities of dedicated stations. Acceptance testing of the Ultrasonic Scanning Mechanism (USM) was successfully completed. Results indicate that the USM is a well designed and well built mechanism. All motions met or exceeded specifications and operated smoothly without mechanical binding or interferences. Elevated temperature tests of USM components were completed. Stepping motors, encoders, limit switches, and cooling fans were shown to be capable of intermittent operation over extended time periods at temperatures as high as 93°C (200°F). An improved transducer configuration has been determined for faster and more accurate ultrasonic scanning. Individual elements are being characterized in the laboratory for this multi-element transducer. Transducer work at Argonne National Laboratory is planned to develop a wedge suitable for the FFTF inspection.

54865 (INIS-mf—4905, pp 287-335) **Methods of testing materials in research reactors.** Tsykanov, V.A. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Methodical features of testing structural and fuel reactor materials in contemporary high-flux research reactors are surveyed. Techniques of determining irradiation conditions and their in-process regulation are discussed. The merits and dimerits of in pile loops and irradiation capsules are compared. Design criteria of experimental equipment for testing mechanical, thermophysical and electrophysical properties of materials and reactor fuel off-gassing under irradiation are provided. The urgent need for pulsed facilities (pulsed reactors, accelerators) is stated which provide an opportunity to study nonstationary processes.

54866 (ORNL/TM—6911) **Bulk shielding facility quarterly report, January-March 1979.** Hurt, S.S.; Lance, E.D.; Howard, K.E. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

The BSR was operated at an average power of 1,815 kW for 77.64% of the time this quarter. Water quality control in both the primary and secondary cooling systems was satisfactory. The PCA was operated 182.80 hours for the usual training activities involving university students and TVA personnel.

54867 (ORNL/TM—7006) **High flux isotope reactor. Quarterly report January, February and March of 1979.** Corbett, B.L.; McCord, R.V.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

Routine reactor operation with four end-of-cycle shutdowns resulted in a on-stream time of 94.0%. The semiannual reactor component inspection was completed and the control plates were changed. There were no unscheduled shutdowns.

54868 (SAND—79-1646C) **Design and proposed utilization of the Sandia Annular Core Research Reactor (ACRR).** Walker, J.V.; Reuscher, J.A.; Pickard, P.S. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 12p. (CONF-790816—53). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The Sandia ACRR became operational in 1978 and currently serves as the major in-pile fast reactor safety test facility for the US Nuclear Regulatory Commission. The ACRR is an upgrade of the Annular Core Pulse Reactor (ACPR) with the installation of a new flexible control system and a core of uniquely designed BeO-UO_2 fuel elements for increasing the neutron fluence in the experiment cavity. The reactor is now capable of driving multi-pin advanced reactor test fuel into vapor with a pulse width of 5 msec. In the steady state mode, the reactor can simulate post accident decay heat at prototypic levels in fission heated debris beds up to 10 cm in diameter. A number of programmed operating modes including high power square waves, ramps and pulses can produce a multitude of power profiles in order to simulate the power histories in the various accident scenarios. The reactor capabilities and the reactor safety research test program are discussed.

54869 (TREE—1373) **SPERT-IV; Decontamination and Decommissioning. Final report.** Smith, D.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 50p. Dep. NTIS, PC A03/MF A01.

This report describes the Decontamination and Decommissioning (D and D) of the SPERT-IV reactor building performed during the period December 1978 thru February 1979 by operating personnel under the direction of the D and D Project of EG and G's Waste Management Division. It includes an overview of D and D accomplished, deviations from the D and D plan, and the post-D and D condition of the SPERT-IV reactor building.

54870 (ANL-Trans—1171) **General guide for irradiations in the research and experimental reactor IAN-R1.** Sandoval, E.; Barragan, A.; Casabianca, M. (Instituto de Asuntos Nucleares, Bogota (Colombia). Div. Reactor). Jun 1979. Translation of IAN report, April 1965. 37p. Dep. NTIS, PC A03/MF A01.

In order to render a service to the research personnel of the Institute of Nuclear Affairs and to other organizations interested in using the reactor, the Reactor Division has prepared this General Guide for Irradiations in the IAN-R1 Education and Research Reactor in which are described the possible experimentation sites and their physical characteristics. This Guide also provides basic information on the calculation of activities and reactivity; indicates the procedures for obtaining authorization to use the reactor; points out the most common errors in certain experiments; and suggests the use of some equipment and materials and the elimination of others.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

54871 (UNI-SA—61) **Using quality assurance during maintenance and planned outages.** Snyder, D.A. (UNC Nuclear Industries,

Inc., Richland, WA (USA)). 3 May 1979. Contract EY-76-C-06-1857. 15p. (CONF-790905—2). Dep. NTIS, PC A02/MF A01.

From American Society for Quality Control conference; Las Vegas, NV, USA (24 Sep 1979).

This presentation describes a program of quality assurance for power plant maintenance and some of the benefits realized from such a program at the N Reactor, near Richland, Washington, which is operated by UNC Nuclear Industries for the Department of Energy. The presentation emphasizes surveillance testing and inspection as the heart of the maintenance function, and describes the uses of preventive maintenance, maintenance work controls, and data developed during maintenance work. The principles applied can be utilized at fossil-fueled plants as well as at nuclear facilities.

54872 (UNI-SA—62) **Decontamination of the Hanford N-Reactor in support of continued operation.** Kratzer, W.K. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 16 Aug 1979. Contract EY-76-C-06-1857. 14p. Dep. NTIS, PC A02/MF A01.

N-Reactor is a graphite moderated, light water cooled, horizontal pressure tube pressurized water reactor operated by UNC Nuclear Industries for the United States Department of Energy (DOE). Since the start of operation in 1964, radiation dose rates of piping and components in contact with reactor coolant have gradually increased, requiring a continuing program to mitigate the effects of the increasing activity. The program to minimize personnel exposure involves increasing the efficiency of radiation zone operations, shifting to remote operations where possible, shielding, and decontamination. The purpose of this paper is to describe some of the decontamination activities at N-Reactor applied in support of continued reactor operation.

54873 (UNI-SA—63) **Hanford production reactor decommissioning.** Wahlen, R.K. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 7 Aug 1979. Contract EY-76-C-06-1857. 15p. (CONF-790923—1). Dep. NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

There are nine plutonium production reactors located at the Hanford Site in Richland, Washington. Eight of these reactors have been shutdown, defueled, deactivated and placed in retirement. The ninth reactor is N Reactor which remains in operation. The combined thermal energy developed during operation of all nine reactors was in excess of 20,000 MWt. This required large and complex systems to dissipate the heat generated and to monitor the many parameters incidental to safe and efficient operation of the nuclear reactors. During the last several years, the Department of Energy has been involved in a study to determine the final disposition of the retired government-owned facilities on the Hanford Reservation. Two programs are in progress and are directed towards final disposition of these facilities. First, in 1974, a site cleanup program was started which is involved in the elimination of potential industrial and radiological hazards and the final disposition of clean (free of contamination) facilities. Second, in 1977, UNC Nuclear Industries was authorized to begin the planning necessary to implement full-scale decommissioning of the contaminated portion of one reactor complex. The facility selected for this demonstration program is identified as 100-F. The progress made in these programs, along with some of the techniques being considered in the Decontamination and Decommissioning (D and D) work is included in this report.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 54857, 55059, 55062, 55452

54874 (BNL-NUREG—26572) **Feedback control systems for non-linear simulation of operational transients in LMFBRs.** Khatib-Rahbar, M.; Agrawal, A.K.; Srinivasan, E.S. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 14p. (CONF-790816—48). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Feedback control systems for non-linear simulation of operational transients in LMFBRs are developed. The models include (1) the reactor power control and rod drive mechanism, (2) sodium flow control and pump drive system, (3) steam generator flow control and valve actuator dynamics, and (4) the supervisory control. These models have been incorporated into the SSC code using a flexible approach, in order to accommodate some design dependent variations. The impact of system nonlinearity on the control dynamics is shown to be significant for severe perturbations. Representative result for a 10 cent and 25 cent step insertion of reactivity and a 10% ramp change in load in 40 seconds demonstrate the suitability of this model for study of operational transients without scram in LMFBRs.

54875 (CAAP-TR—054) **Audit calculations for Westinghouse PWR small cold-leg breaks.** Dobbe, C.A.; Fletcher, C.D.; Ross, E.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 43p. Dep. NTIS, PC A03/MF A01.

Audit calculations were performed for the Nuclear Regulatory Commission. Three small-break configurations of a Westinghouse pressurized water reactor were investigated using the RELAP4/MOD7 computer code.

54876 (CEA-N—2025) **Flow and heat transfer thermohydraulic modelisation during the reflooding phase of a P.W.R.'s core.** Raymond, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Eau; Paris-11 Univ., 91 - Orsay (France)). Apr 1978. 162p. (In French). Dep. NTIS (US Sales Only), PC A08/MF A01.

Thesis.

Some generalities about L.O.C.A. are first recalled. The French experimental studies about Emergency Core Cooling System are briefly described. The different heat transfer mechanisms to take into account, according to the flow pattern in the dry zone, and the correlations or methods to calculate them, are defined. Then the Thermohydraulic code computer: FLIRA, which describe the reflooding phase, and a modelisation taking into account the different flow patterns are setted. A first interpretation of ERSEC experiments with a tubular test section shows that it is possible, with this modelisation and some classical heat transfer correlations, to describe the reflooding phase.

54877 (CONF-790802—70) **Fluid-structure interaction analysis of a deck structure during a HCDA.** Kulak, R.F. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Presented is an assessment of the structural integrity of the deck structure of a pool-type LMFBR during a Hypothetical Core Disruptive Accident (HCDA). During this accident the sodium above the core is propelled upward until it impacts against the deck structure. This hydrodynamic loading could produce (1) significant structural damage and (2) sodium leak paths. A finite-element model is used to study the deck dynamics during slug impact. By using the symmetry of the system, a sector model which accounts for the salient features of the system is developed. The main radial I-beam, component support I-beam and bottom annular plate are modeled using triangular plate elements. The concrete fill is modeled using hexahedral continuum elements. Using the above finite-element model the dynamics of the deck during a HCDA are investigated.

54878 (CONF-790816—37) **CRBRP structural and thermal margin beyond the design base.** Strawbridge, L.E. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1979. Contract EY-76-C-15-2395. 13p. Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Although Hypothetical Core Disruptive Accidents (HCDAs) are not Design Basis Accidents for the Clinch River Breeder Reactor Plant, extensive assessments of HCDA consequences have been made. Prudent margins beyond the design base have been included in the design to further reduce the risk to the public from highly improbable occurrences. These margins include Structural Margin Beyond the Design Base to address the energetics aspects and Thermal Margin Beyond the Design Base to address the longer term thermal and radiological consequences. The assessments that led to the specification of these margins are described, along with the experimental support for those assessments.

54879 (CONF-791103—4(Summ)) **Assessment of the RELAP4/MOD6 reactor transient thermal-hydraulic code.** Haigh, W.S.; Charlton, T.R.; Dearien, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The RELAP4/MOD6 transient analysis code is the most recently released of a set of computer programs designed for calculation of the thermal-hydraulic behavior of a light water reactor (LWR) during the transient phases of a postulated loss-of-coolant accident. Earlier versions of RELAP4 primarily had capability for analysis of blowdown and refill phenomena. With RELAP4/MOD6, this capability has been extended through the core reflood range, uniquely providing a best estimate analysis code for the entire accident period. The code has been assessed by comparing and evaluating calculations with results of a broad selection of reactor safety experiments. This assessment represents a new procedure that incorporates the results of code-data comparisons and evaluations made under controlled user-oriented conditions and introduces a conventional statistical approach to the analysis of code prediction uncertainties. The assessement procedure quantifies the uncertainties in the code in application to the modeling of experiments varying in size, scale, and scope.

54880 (CONF-791103—6) **Potential for fuel melting and cladding thermal failure during a PCM event in LWRs.** El-Genk, M.S.; Croucher, D.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The primary concern in nuclear reactor safety is to ensure that no conceivable accident, whether initiated by a failure of the reactor system or by incorrect operation, will lead to a dangerous release of radiation to the environment. A number of hypothesized off-normal power or cooling conditions, generally termed as power-cooling-mismatch (PCM) accidents, are considered in the safety analysis of light water reactors (LWRs). During a PCM accident, film boiling may occur at the cladding surface and cause a rapid temperature increase in the fuel and the cladding, perhaps producing embrittlement of the zircaloy cladding by oxidation. Molten fuel may be produced at the center of the pellets, extrude radially through open cracks in the outer, unmelted portion of the pellet and relocate in the fuel-cladding gap. If the amount of extruded molten fuel is sufficient to establish contact with the cladding, which is at a high temperature during film boiling, the zircaloy cladding may melt. The present work assesses the potential for central fuel melting and thermal failure of the zircaloy cladding due to melting upon being contacted by extruded molten UO_2-fuel during a PCM event.

54881 (CONF-791103—9) **Method for quantitative assessment of nuclear safety computer codes.** Dearien, J.A.; Davis, C.B.; Matthews, L.J. (Idaho National Engineering Lab., Idaho Falls (USA); Idaho State Univ., Pocatello (USA)). 1979. Contract EY-76-C-07-1570. 2p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A procedure has been developed for the quantitative assessment of nuclear safety computer codes and tested by comparison of RELAP4/MOD6 predictions with results from two Semiscale tests. This paper describes the developed procedure, the application of the procedure to the Semiscale tests, and the results obtained from the comparison.

54882 (CONF-791103—18(Summ.)) **Carryover rate fraction correlation for LOFT safety analysis calculations.** Lin, J.C.; White, J.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Loss-of-Fluid Test (LOFT) facility contains a pressurized water nuclear reactor designed to scale the nuclear, thermal-hydraulic phenomena which would take place in a large pressurized water reactor (PWR) during a hypothetical loss-of-coolant accident (LOCA). This summary describes the development of a carryover rate fraction (CRF) correlation suitable for use in an evaluation model calculation for the reflooding phase of a LOFT experiment as well as the 3.6576-m core skewed axial power shape case. The CRF is defined as the ratio of mass rate entrained out of the core to the mass rate into the core.

54883 (CONF-791103—19) **Behavior of a nine-rod PWR bundle under power-cooling-mismatch conditions.** Gunnerson, F.S.; Sparks, D.T. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

An experiment to characterize the behavior of a nine-rod pressurized water reactor (PWR) fuel bundle operating during power-cooling-mismatch (PCM) conditions has been conducted in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory (INEL). The experiment, designated Test PCM-5, is part of a series of PCM experiments designed to evaluate light water reactor (LWR) fuel rod response under postulated accident conditions. Test PCM-5 was the first nine-rod bundle experiment in the PCM test series. The primary objectives and the results of the experiment are described.

54884 (CONF-791103—22(Summ.)) **Bond graph methods in reactor dynamics.** Neff, G.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The use of bond graphs for analysis and simulation of structural dynamics problems is increasing in industry. However, it has yet to be shown how the ease and simplicity of bond graphs can be applied in predicting reactor fuel behavior. This summary describes how bond graphs are utilized to predict the dynamic response of a pressurized water reactor fuel assembly subjected to a loss-of-coolant experiment transient.

54885 (CONF-791103—25) **Molten fuel containment analysis for SLSF experiments.** El-Genk, M.S.; Moore, R.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Sodium Loop Safety Facility (SLSF) experiments are being conducted in the Engineering Test Reactor (ETR) at the Idaho National Engineering Laboratory to furnish information concerning the behavior of fast reactor fuel elements under a hypothesized loss-of-flow accident conditions. These experiments involve measurements and observations that will permit an assessment of the location and time of sodium void initiation, the nature of sodium expulsion and reentry, the time and nature of cladding failure and motion, the molten fuel motion, and the extent of flow plugging by molten fuel freezing at the axial extremities of the subassembly. Because such high energy experiments are being conducted in-pile within the ETR facility, extensive pretest analysis was required to ensure loop integrity. One aspect of this analysis, which is the subject of this paper, was the assessment of molten fuel relocation and refreezing on the wall of the SLSF.

54886 (CONF-791103—26) **Molten fuel radial motion during a high temperature transient in LWRS.** El-Genk, M.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Molten fuel radial motion during a high temperature transient is of interest to current light water reactor (LWR) safety analyses. Particularly, since partial or complete melting of the zircaloy cladding may occur upon the cladding being contacted by molten UO_2-fuel, because of the large difference between the melting point of the fuel and that of the cladding. During a high temperature transient, fuel melting may be initiated at the center of the rods and propagate radially outwards. Fuel cracking, which usually occurs along radial and horizontal planes in the fuel pellet during reactor normal operation provides paths for such molten fuel to relocate outside the central melting zone. This paper presents an analytical study of the transient freezing of a superheated liquid that penetrates an initially empty crack maintained at a constant subfreezing temperature. Results of the analysis are applied to assess the molten UO_2 fuel radial extrusion observed in some of the in-pile tests in which power-cooling-mismatch (PCM) conditions in a pressurized water reactor were simulated.

54887 (CONF-791103—27(Summ.)) **Blowdown hydraulic influence on core thermal response in LOFT nuclear experiment L2-3.** Reeder, D.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Experimental research into pressurized water reactor (PWR) loss-of-coolant phenomena conducted in the Loss-of-Fluid Test (LOFT) facility has given results indicating that for very large pipe breaks the core thermal response is tightly coupled to the fluid hydraulic phenomena during the blowdown phase of the loss-of-coolant transient. This summary presents and discusses data supporting this conclusion. LOFT Loss-of-Coolant Experiment (LOCE) L2-3 simulated a complete double-ended offset shear break of a primary coolant reactor vessel inlet pipe in a commercial PWR. The LOFT system conditions at experiment initiation were: fuel rod maximum linear heat generation rate (MLHGR) of 39.4 +- 3 kW/m, hot leg temperature of 593 +- 3 K, core ΔT of 32.2 +- 4 K, system pressure of 15.06 +- 0.03 MPa, and flow rate/system volume of 25.6 +- 0.8 kg/m^3. These conditions are typical of those in commercial PWR systems at normal operating conditions.

54888 (CONF-791103—28(Summ)) **Posttest analysis of LOFT LOCE L2-3 using the ESA RELAP4 blowdown model.** Perryman, J.L.; Samuels, T.K.; Cooper, C.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A posttest analysis of the blowdown portion of Loss-of-Coolant Experiment (LOCE) L2-3, which was conducted in the Loss-of-Fluid Test (LOFT) facility, was performed using the experiment safety analysis (ESA) RELAP4/MOD5 computer model. Measured experimental parameters were compared with the calculations in order to assess the conservatisms in the ESA RELAP4/MOD5 model.

54889 (CONF-791103—29(Summ)) **Nuclear fuel rod response during LOFT tests L2-2 and L2-3.** Niebruegge, D.A.; Tolman, E.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Comparisons of the measured fuel rod peak cladding temperatures for the first two nuclear loss-of-coolant experiments (LOCE), LOCEs L2-2 and L2-3, are presented. These LOCEs were performed in the Loss-of-Fluid Test (LOFT) facility at the Idaho National Engineering Laboratory. The LOCEs provided a basis for evaluating the effect of initial power on the maximum cladding temperatures during a large break (200%, guillotine) LOCE and identified important core thermal-hydraulic responses that influence the peak cladding temperatures.

54890 Tolerance analysis by computer. Cox, N.D. (Edgerton, Germeshausen and Grier Idaho, Inc, Idaho Falls). *J. Qual. Technol.;* **11**: No. 2, 80-87(Apr 1979).

An improved error propagation technique was needed for the analysis of nuclear reactor safety systems. In response, a computer program for calculating the first four moments of a second-order function was prepared and validated. This program, called SOERP, can accommodate up to 30 statistically independent random variables. Thus, the moments for any function that can be expanded in a multivariable Taylor series up to the second order can be estimated. These moments can then be used to determine a probability density function describing the dependent variable. The above two steps represent a method for evaluating a complex system's performance fluctuations that arise from random variability in the behavior of system components. For example, tolerance limits on the performance of electrical circuits or on transit times in a repair facility may be evaluated more precisely. Another application is the evaluation of profitability calculations in which the input data are subject to uncertainty.

54891 (ETEC-TDR—78-19(Suppl.)) **Study of safety relief valve operation under ATWS conditions.** Hutmacher, E.S.; Whitten, S.D. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 25 Jul 1979. Contract EY-76-C-03-0700. 35p. Dep. NTIS, PC A03/MF A01.

In March 1979, ETLC published as ETEC-TDR-78-19 a search which updated earlier NRC studies of saturated or subcooled water flow through relief valves, under ATWS conditions. This Supplement expands upon that search to include supercritical steam-water flow. No applicable data for the supercritical conditions was found, nor were any newer data on saturated or subcooled conditions uncovered. The Supplement also updated a look for facilities currently capable of simultaneously imposing all ATWS conditions upon test relief valves. Results confirmed the negative findings of ETEC-TDR-78.19.

54892 (GA-A—15402) **Methodology for risk assessment of major fires and its application to an HTGR plant.** Fleming, K.N.; Houghton, W.J.; Scaletta, F.P. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract AT03-76ET35300. 107p. Dep. NTIS, PC A06/MF A01.

A risk assessment methodology is presented for a specific class of reactor accidents, major fires. Principal elements of the methodology include collection and interpretation of experience data, identification and screening of important fire locations, event tree/fault tree analysis, and accident consequence assessment. About 900 reactor-years experience was examined for reported fires either during construction or plant operation. Statistical analyses were performed of fire initiation and progression characteristics such as occurrence rate, distance of fire spread, and time to bring fire under control.

54893 (GA-A—15507) **Seismic design of GCFR core support system.** Chuang, A.S.; Jones, H. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract EY-76-C-03-0167-023. 28p. Dep. NTIS, PC A03/MF A01.

For an unrestrained GCFR core, such as the reference downflow core, the criterion for determining the thickness of the grid plate is the limitation of 10 cents reactivity change due to the transient pressure history during the loss of coolant accident. In the case of a restrained core, there will be little reactivity change caused by the limited radial motion of the core elements. As a result the initial grid plate deflection-limited core support will not be governed by the vertical seismic response of the core/core support system. It is proposed that for conceptual sizing studies a conservative thickness for the grid plate be determined. The fundamental vertical frequency of the system will be made at least 1-1/2 times higher than the fundamental vertical frequency of the PCRV for the appropriate site and soil conditions. When the in-structure design response spectra for the core support structure are available the actual dynamic response of the system will be investigated and an optimum thickness calculated.

54894 (GEFR—00395) **Study of transient sodium boiling in LMFBR fuel bundles.** Shih, T.A. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Apr 1979. Contract EY-76-C-03-0893-032. 78p. AT.

An assessment of the dynamics of sodium boiling in LMFBR fuel bundles undergoing transient undercooling events has been performed and is reported. Since there is no suitable two-dimensional analytical tool available for such evaluation, the analysis was conducted using special overlays of existing computer codes and approximation methods. An attempt was also made to develop a simple multi-channel model which is capable of predicting axial and radial boiling progression and the time of inlet flow reversal. Analytical predictions obtained with this model were compared with available experimental results and were judged satisfactory for use in near-term safety test design engineering.

54895 (GEFR—00444) **TRANSWRAP-II analyes of the Stanford Research Institute IHTS/relief system simulation tests.** Wolfe, C.F. Jr. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Apr 1979. Contract EY-76-C-03-0893-030. 254p. AT.

Tests were performed by the Stanford Research Institute (SRI), Menlo Park, California, in which the time histories of acoustical pressure pulses were measured at various locations in a water loop that simulaed a LMFBR intermediate heat transport and pressure relief system. This report focuses on the computer simulation of these experiments, and the comparison of the analytical results to corresponding measured values. The report shows that TRANSWRAP has the capability to predict adequately the pressure response of the SRI scale model of an LMFBR IHTS. Fluid velocities in the relief line are shown to be conservatively predicted.

54896 (GKSS—78/E/36) **Analytical simulation of the containment performance during LOCA.** Schwan, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1978. 33p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

The paper gives a survey of the formulations for an analytical description of the containment performance during LOCA and indicates the essential parameters of influence. The analytically relevant heat transfer conditions and air transport mechnisms within the containment are treated in more detail. The heat transfer relations established are part of the containment code CORAN developed at GKSS. Their influence on the analytical results is demonstrated by the example of the Batelle experiment D1.

54897 (IDO—1570-T16) **Fuel train instrumentation used in the Thermal Fuels Behavior Program.** Therp, K.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 40p. Dep. NTIS, PC A03/MF A01.

The Thermal Fuels Behavior Program (TFBP) has developed, applied, and assessed instrumentation devices which are used to measure the characteristics of nuclear fuel rod assemblies during tests under normal, abnormal, and accident conditions. The devices have evolved over a series of tests and are now being successfully used to characterize nuclear fuel rod features during loss-of-coolant accident (LOCA)-, reactivity-insertion accident (RIA)-, power-cooling-mismatch (PCM)-, and gap conductance-type experiments. This paper describes the fuel assembly instrumentation, application, and performance as applied to the TFBP test assemblies.

54898 (INIS-mf—4506, pp vp) **Significance of warm prestress to crack initiation during thermal shock.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

During a loss of coolant accident, LOCA, followed by operation of the emergency core cooling system, the inside wall of a nuclear pressure vessel is subjected to high thermal stresses that can cause extension of a preexisting flaw. During this event the crack-tip stress intensity factor, Ksub(I), may achieve its maximum value early in the transient, but the critical level for crack initiation, Ksub(Ic) may not be reached until minutes later at which time the loading has decreased from its peak. It is believed that this phenomenon, termed warm prestress, WPS, can preclude crack extension when Ksub(I) equals Ksub(Ic). NRL has conducted an experimental study, employing three-point bend specimens, to investigate the potential elevation in Ksub(Ic) by WPS, and to translate the significance of this behavior into structural terms in the sense of minimizing crack extension in a nuclear vessel during a LOCA. From the experiments it is concluded that the mechanisms associated with WPS act to elevate the Ksub(Ic) of the material at the crack tip and that this fact can greatly minimize crack extension that would have been predicted without consideration of WPS. The experiments demonstrated that failure never occurs during the unloading portion of the simulated LOCA path. This finding is of major significance to the integrity of a vessel. For example, with relatively deep cracks, initiation ordinarily would be predicted as Ksub(Ic) is reached along a decreasing Ksub(I) path. For this set of conditions the present research studies have shown that the WPS phenomenon will preclude all crack initiation.

54899 (INIS-mf—4506, pp vp) **Thermal shock studies associated with injection of emergency core coolant in pressurized water reactors.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The LOCA-ECC Thermal Shock Program was established to investigate the potential for flaw propagation in pressurized-water reactor (PWR) vessels during injection of emergency core coolant following a loss-of-coolant accident. Studies thus far have included fracture mechanics analysis of typical PWRs, the design and construction of a thermal shock test facility, determination of material properties for thermal shock test specimens, and three thermal shock experiments. A potential for flaw propagation exists because a LOCA-ECC thermal shock would induce high tensile stresses in the inner portion of the vessel wall, and because the reduced temperature and eventually the fast neutron fluence would reduce the material toughness in the same area (belt-line region). Calculations indicate that present generation PWR vessels are not likely to experience crack initiation. However, earlier vessels, which have a relatively high concentration of copper impurity and thus tend to suffer greater radiation damage, are subject to propagation of preexisting flaws. Thus, an experimental verification of the methods of analysis (linear elastic fracture mechanics) was in order. The test specimens were hollow cylinders with a 530 mm OD (21-in.) and 150 mm wall (6-in.). They were fabricated from A508 class 2 material, and radiation embrittlement was simulated to some extent by using a quench-only heat treatment. The desired thermal shock was achieved by suddenly pumping a low temperature coolant through the initially hot test specimen. Coolant temperatures as low as -23°C (-10°F) have been used with a test specimen initial temperature of 288°C (550°F). The fluid-film heat transfer coefficient was controlled by adjusting the coolant velocity.

54900 (INIS-mf—4506, pp vp) **Elastoplastic and nonsymmetric buckling analysis by finite element of Super-Phenix primary vessel head.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54901 (INIS-mf—4541, pp vp) **Transient dynamic response and stability analysis of reactor core-support barrel due to LOCA pressure pulse loading.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54902 (INIS-mf—4541, pp vp) **Damping of reactor internals.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper presents and discusses the results of a study of internals damping using data obtained from wave analysis of PWR plant flow tests, and shaker tests. The damping values were obtained from vibration data taken during the pre-operational testing of several reactor plants and some in air shaker tests. Parameters available in the data include the presence of the core, the presence and position of the control rod drive line, reactor coolant temperature, and combination of reactor coolant pumps in operation. Modal damping values for the structures reported were obtained from the decay of autocorrellograms or from the modal response half-power bandwidths of frequency spectra. For the lower frequency core barrel-reactor vessel beam modes 2% to 5% damping values were found for minimum damping values. Significantly higher values are found in the data when, for example, intermittent contact occurs at the core barrel level supports. Core barrel and thermal shield shell modes having natural frequencies in the frequency range of interest for seismic response calculations exhibit damping values generally on the order of 1% to 2%. Higher frequency, very low amplitude, shell modes of these structures can have damping values of less than 1%. Damping values for guide tubes were found to have minimum values of 2% to 5% depending on their core location. The cross flow velocity and thus the floor turbulence excited amplitude is higher for guide tubes in core locations near the outlet nozzles. Information on the damping of upper support columns which are similarly excited is also given. Damping values reported are suitable for normal operation design conditions, i.e., for oscillatory behavior and relatively small amplitudes. The extrapolation of the data to obtain realistic values for large seismic events and for loss of coolant accidents is also discussed.

54903 (INIS-mf—4541, pp vp) **Explosive rupture of a power channel pressure tube in a D_2O moderated reactor.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

For the D_2O moderated reactors, the explosive rupture of a power channel pressure tube is one of the hypothetical accidents which are to be considered for the full assessment of the system safety. The purpose of this paper is to give a coherent presentation of the main aspects and problems encountered in the evaluation of the consequences of this hypothetical accident. The explosive rupture of the pressure tube is assumed to be due to the fast propagation of a longitudinal crack of critical length. The accident dynamics is determined primarily by how the rupture area free for coolant discharge develops in time and shape. In one experiment for CIRENE reactor, critical crack propagation in the pressure tube was rapidly stopped, probably by the fast pressurization of the annular volume, and the rupture area was limited to about 20 cm^2, and the calandria tube did not fail. Similarly, no failures were observed in the full-scale tests for CANDU reactor. If the calandria tube does not fail, the consequences of pressure tube rupture remain fully confined within that power channel. On the contrary, in the case of calandria tube explosive rupture, a relevant pressure transient is triggered in the D_2O tank. An upper limit on the consequences of this failure possibility can be derived from full scale burst tests having the exploding pressure tube not surrounded by its calandria tube. Several burst tests of this type were performed for CIRENE reactor on a special plant at Ispra Euratom JRC. The results obtained in the first phase of the experimental program, presented at SMIRT 3. Paper F 8/2, were confirmed by the tests of the second phase of the program. For the case of CIRENE reactor it can be concluded that even in the most severe accident conceivable, pressure tube rupture propagation from one power channel to the adjacent one is very unlikely and do not produce any relevant damage to the main structural functions.

54904 (INIS-mf—4541, pp vp) **Dynamic fracture mechanics analysis of hydrogen embrittlement of Zr-2.5Nb pressure tube.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper describes the dynamic fracture behavior of heat treated Zr-2.5 Nb pressure tube which is used for the Prototype Heavy Water Reactor 'FUGEN' that is under construction by the Power Reactor and Nuclear Fuel Development Corporation. Hydrogen is picked up by the reactor pressure tube from the water coolant. The hydrogen concentrates in regions with stress concentrations and the regions become very brittle. Therefore, in designing structures and safety systems, the effects of stress on hydrogen density and hydrogen concentration must be taken into consideration. When a local fracture initiates in a brittle region it must be arrested in order to prevent unstable fracture of the pressure tube. Four experiments were done in order to clarify the dynamic fracture behaviors of the pressure tubes: a leak before rupture experiment using tube specimens with a part-through-crack under internal repeated pressure; a dynamic fracture toughness experiment using drop weight equipment at temperature to 300°C; a crack arrest experiment using a double cantilever tube specimen under wedge force; and a hydrogen enrichment and concentration experiment with the specimen subjected to various stresses. The main results of these experiments when the concentration of hydrogen is 300 ppm, which is higher than the concentration after 30 years of plant operation, are given. These test results are discussed systematically from the view of dynamic fracture mechanics. The conclusion obtained is that the pressure tubes with detectable flaws might be used safety, even if they are irradiated with coolant water at 300°C and then stressed at room temperature.

54905 (INIS-mf—4543, pp vp) **Plastic strain accumulation bounds in a two bar thermal ratchetting mechanism.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A two bar thermal ratchetting assembly presents an interesting application to the ratchetting problem. First it is based on a more realistic tension-compression mechanism that exists through the thickness of a loaded shell if it can be conservatively assumed that the tension and compression zones are not connected. Second, the equal area equal properties two bar assembly gives same results as Bree's TRG-Report 1214(D), (1966), thereby assumes an equal tension-equal compression mechanism such as may exist in axisymmetric behaviors. Third, the unequal area unequal properties two bar assembly of Ref. [1] may help towards application to wider range of problems. Further, the work in Ref. [1] helps to provide a study of the thermal ratchetting behavior in an unequal area, unequal properties two bar assembly with strain hardening material behavior. The elastic analysis based simplified elastic-plastic analysis fatigue rules of Code Case 1592 require the determination of total strain. The work presented here defines the elastic analysis based simplified elastic-plastic design rules. In addition, total accumulated plastic strains are derived for the regions of ratchetting, captive plastic and plastic cycling. From these expressions, the limiting plastic strains are derived and the strain bounds developed. Resulting simplicity is in obtaining a realistic value of plastic strain to be used in Eq.(1) which provides considerable improvement in the procedures of Code Case 1592. Since the simplified analysis procedures of ASME Code are essentially based on Bree's work, and since the results of Ref.[1], reduced to equal area two bar ratchetting assembly, agree with Bree's results the improvements presented here lie within acceptable guidelines.

54906 (INIS-mf—4543, pp vp) **Some comments on thermomechanical constitutive equations for inelastic analysis of LMFBR components.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The safety analysis of the primary and secondary circuits of sodium-cooled fast breeder reactors (LMFBR) requires systematic methods to predict the inelastic behaviors of metal structures under complex thermomechanical loading conditions. To provide those methods, constitutive equations have been recommended for interim use. This paper is concerned with the physical evidence and consistency of these constitutive equations. In particular, shortcomings of the recommended constitutive theories may result from the bilinear approximation of the stress-strain-curve, the kinematic linear hardening rule and the very special kind of the proposed creep laws. Moreover, the elastic-plastic and creep equations are formulated independently: except for hardening due to prior creep strains, possible interactions between viscoelastic and plastic material behaviors are neglected. Finally, the temperature appears as a given parameter, that means. The recommended constitutive assumptions do not allow for any coupling effects between the deformation and temperature field. A consistent set of constitutive equations should be based on a correct evaluation of the second law of thermodynamics. Looking at the specific mathematical form of the recommended constitutive theories, one can generalize the classical elastic-plastic and creep equations. However, in a more systematic approach to the problem of inelastic analysis, general results of the modern theories of non-linear material behavior should be utilized. These results provide systematic methods to establish constitutive equations which are thermomechanically consistent as well as experimentally practicable.

54907 (INIS-mf—4592) **Thermal and stress analyses of meltdown cups for LMFBR safety experiments using SLSF in-reactor loops.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.E)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The test trains for the Sodium Loop Safety Facility (SLSF) in-reactor experiments, which simulate hypothetical LMFBR accidents, have a meltdown cup to protect the primary containment from the effects of molten materials. Thermal and stress analyses were performed on the cup which is designed to contain 3.6 kg of molten fuel and 2.4 kg of molten steel. The cup principal components are: 1. A 38 mm diameter tungsten spike which provides initial fuel quenching and prevents fuel boiling, 2. A 73 mm inside diameter tungsten liner to isolate the support vessel from the molten material high initial temperature, 3. An insulator which is an expedient for extending the experiment time, and 4. An Inconel 625 vessel which provides the structural support to withstand the thermal and pressure stresses. The spike, liner, and insulator are supported by a hemispherical tungsten end cap which fits inside the hemispherical bottom of the support vessel. This vessel is attached to the 316 stainless steel test train with an Inconel 750 wire-formed retaining ring. Thermal analyses were performed with the Argonne-modified version of the general heat transfer code THTB, based on the instantaneous addition of 3200°K molten fuel with a decay heat of 9 W/gm and 1920°K molten steel. These analyses have shown that the cup will adequately cool the molten materials. The maximum temperature occurs at the center of the fuel region but it is always less than the fuel boiling point. The maximum temperature occurs at the center of the fuel region but it is always less than the fuel boiling point. The most severe heating occurs when there is no sodium flow outside the cup. For this case the sodium boils (approximately 1200°K) and the Inconel vessel and tungsten liner temperatures are approximately 1250°K and 2420°K, respectively.

54908 (INIS-mf—4592) **Effects of spacers on blockage of coolant channels in clad melting accidents.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.E)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The elements and configuration of these assemblies are representative of the current design for a GCFR. The fuel elements are stainless-steel clad, mixed-oxide spaced by a grid structure on 250 mm centers with a pitch of 9.5 mm, diameter, 7.2 mm, and cladding thickness, 0.5 m. Three series of experiments have been conducted to study the flow and disposition of molten cladding metal into a lower powered blanket region of the reactor following a loss of flow situation. The first two series used a simulant fuel-element bundle to simplify the experimental procedure and make visual observation possible. The 'fuel' was simulated by mullite rods 6.4 mm in diameter and 610 mm long. These were clad with a 50 Pb/50 Sn alloy tubing which was drawn onto the 'fuel'. The first series used cast spacers with webs of about 0.5-0.55 mm thickness placed 175 and 425 mm from the top end of the assembly. The second series used grid spacers fabricated of 0.25 mm alloy strips. This provided a more accurate representation of the hydraulic diameter. The bundle was encased in a hexagonal glass tube. The bundle was at 22°C and the molten alloy was poured at a temperature of 260°C (35°C superheat). Motion pictures recorded the experiments and the bundle was sectioned for observation. The third set of experiments was done with a stainless steel bundle of 37 elements fabricated of mullite rods, 7.14 mm diameter. The stainless steel cladding had an O.D. of 8.41 mm. The element pitch was 11.1 mm. The grid spacers were prototypic. The experiment was conducted in an inert-gas tube furnace. The 'core fuel' cladding was melted in an induction furnace and the molten liquid flowed through the center seven element channels. X-ray pictures were taken after the tests and the bundle was sectioned for further study.

54909 (INIS-mf—4592, pp vp) **Bulk coolant cavitation in LMFBR containment loading following a whole-core explosion.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

An LMFBR core undergoing an explosion transmits energy to the containment in a series of pressure waves and the containment loading is determined by their cumulative effect. Pressure waves are modified by their interaction with the coolant through which they propagate. In liquids in their normal state the main effect of the interaction is to steepen the fronts of waves leading to shock formation but in liquids which have undergone bulk cavitation the interaction is much stronger and is expected to be dissipative and dispersive. Since reflections of initial pressure waves from the core at free surfaces lead to the establishment of a state of tension and consequently of bulk cavitation over large volumes of the coolant, it is necessary to model both the induction of bulk cavitation by tension waves and the interaction of pressure waves with cavitated liquid in realistic containment loading calculations. The progress which has been achieved in such modelling and first indications for the effect of bulk coolant cavitation in LMFBR containment loading. A model describing the interaction between cavitation bubbles and a host liquid subject to time-varying pressure fields, including the physical process of momentum conservation, phase change, heat conduction and mass diffusion is presented and used to determine which of the various physical processes involved dominate the results. It is shown that if only interested in bulk effects momentum transfer is the chief factor for the pressures and timescales of interest. To determine the effect of the state of purity of the liquid, thehe main characterising parameters are the initial radii of nucleation sites and their number density, the latter being very influential. To identify the important differences between model water and reactor sodium as far as cavitation is concerned are chiefly the lower surface tension and higher concentration of initially larger nucleation sites in the sodium.

54910 (INIS-mf—4592, pp vp) **Vapor transport and pressure rise behind the liner of reactor containments.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54911 (INIS-mf—4592, pp vp) **Structural response of large LMFBR head closures to hypothetical core disruptive accidents.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A finite-element model was developed to assess the ability of a pool-type LMFBR head closure to sustain an energetic HCDA. From a conceptual representation of an expanded EBR-II type deck, it was determined that there is a reasonable amount of symmetry in the structure that an initial model would consist of a 12° sector. This model accounts for the main structural elements of the closure head: beams, plates, inner ring, in-tank component nozzle and concrete shielding. The mass of the in-tank component was treated as a concentrated mass located at its attachment to the structural members. The ANL-developed SADCAT code was used in this study. The code is an explicit, three-dimensional finite-element code developed for analyzing transient, nonlinear, structural problems. The code has a triangular plate element and a three-dimensional continuum element. The above model was used to study the effect of several design variations on the structural response of the deck to an energetic HCDA. Two types of outer boundary conditions were considered to determine their effect on the closure head's displacements and stress levels. In addition to the above study, an analysis was conducted to determine the structural condition of the concrete shielding. Based upon the above preliminary calculations of pool-type LMFBR head closures, it is indicated that the shield-deck can be designed to survive the given HCDA loads without failure.

54912 (INIS-mf—4592, pp vp) **Response of fast reactor primary containments to whole core accident loadings.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54913 (INIS-mf—4592, pp vp) **Structural dynamics studies for single and clustered SNR-300 fuel elements: a comparison of analytical and experimental results.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Structural damage may occur in liquid metal cooled fast breeder reactors (LMFBR) when local failures escalate to a fast release of excessive thermal energy within one fuel element. Time scales (5. to 50. msec) and peaks of associated pressure pulses (50. to 500. bar) may exceed the burst pressure of the hexagonal wrapper containing the pin-bundle. Though after fuel element rupture the pressure level in the vicinity is markedly reduced, still a significant pressure field is propagating through the core. Therefore surrounding subassemblies or control rods are exposed to impulsive differential pressures causing duct flexure as well as local cross section deformation. A theoretical and experimental research program at GfK Karlsruhe investigates the mechanical effects of conservative pressure transients on LMFBR fuel elements. As part of the program this paper describes two computer codes (BEDYN-2, CORE-1) for non-linear structural dynamics of single as well as clustered subassemblies. Important features and idealizations of mechanical models are discussed before the codes are applied to several loading cases. Then two types of subassembly deformation experiments are outlined, and original records of the pressure pulses are used as input for BEDYN-2 to predict and compare deformation histories with experimental findings: (1) Quasistatic plane strain flat-to-flat loading of the hexagonal wrapper with and without the stiffening pin-bundle. (2) Transverse impulsive loading of a complete 1:1 SNR-300 type fuel element model on roller supports. In addition, pressure records from underwater explosion tests on SNR code models are taken as input for the multirow dynamics code CORE-1 and fairly good correlations were found between measured and predicted permanent deformations.

54914 (INIS-mf—4592, pp vp) **Energy source for modeling HCDA bubbles.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This work describes the development and characterization of an energy source that models the assumed initial conditions and the subsequent expansion of an HCDA bubble in a simple 1/30-scale model of the Clinch River Breeder Reactor (CRBR). The source is used in a study of the phenomena associated with expanding, rising HCDA bubbles, the transport of radioactive core materials to the cover gas region, and the loading resulting from the impact of the coolant slug with the vessel cover. The source uses high-temperature, high-pressure water as the bubble material. The water, initially in the vessel's lower core, is released by opening an explosively driven, fast-opening valve between the lower and upper core barrel. When released, the water reaches a superheated state and flashes to vapor. The vapor expands out of the lower core, through the upper core barrel, and into the vessel containing the coolant simulant (water). High-speed photography is used to observe the expansion through the transparent walls of the vessel. Characterization tests were performed with and without a vessel cover and with both nitrogen gas (1500 psi, room temperature) and water (1160 psi, 563°F, 0% quality) as the bubble material. The surface motion, bubble volume, pressures in the lower and upper core, and the slug impact pressure were measured. From these, the displaced volume-time, entrainment-time, pressure-volume change, gas-work-volume change, and slug kinetic energy-volume change relations were derived.

54915 (INIS-mf—4592, pp vp) **Simulation study of the secondary rupture of SG tubing for LMFBR.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper, which is a part of a large research program for safety design of SG, intends to present and discuss the results of a simulation study made to determine the water injection rate and the tube fracture aspect as a function of the wastage shape. In the experiments, pre-milled aluminium tubes were allowed to burst under internal pressure given by water at room temperature. Aluminium was used because the mechanical properties were similar to those of the steel under the actual service conditions. The wastage was typified by two kinds of artificial surface flaw: one the flat bottom groove milled along the length of the tube (the flat flaw) and the other the oval concave milled by running a cylinder grinder bar transverse to the tube axis (the cylindrical flaw), the length (flat flaw) and the radius (cylindrical flaw) as well as the thickness remaining underneath the flaw being the variables. The inner diameter of the test tube was always 19.4 mm, while the wall thickness was so varied between 1.2 and 2.6 mm that thee underflaw wall be selectable between 0.6 and 1.6 mm for the burst pressure to be between 80 and 200 kg/cm^2. To determine the water injection rate, the pressure history was measured by semi-conductor transducers at two points near the flaw; and the progress of crack opening was recorded by stroboflash photography. The water injection rates calculated on those two measurements will be presented. It will be shown that the time the injection rate became constant was several tenths of a msec for the flat flaws and several msec for the cylindrical flaws, and that the time the crack opened to 90% of the maximum was again several tenths of a msec for the former and several msec for the latter.

54916 (INIS-mf—4638, pp vp) **Dynamic analysis of multibody system immersed in a fluid medium.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper is concerned primarily with the development and evaluation of an analysis method for the response prediction of immersed multibody systems to seismic and other dynamic excitations. For immersed multibody systems to seismic and other dynamic excitations. For immersed multibody systems, the hydrodynamic interaction causes coupled motion among the solid bodies. Also, under intense external excitations, impact between bodies may occur. The complex character of such systems inhibit the use of conventional analytical solutions in closed form. Therefore, approximate numerical schemes have been devised. For an incompressible, inviscid fluid, the hydrodynamic forces exerted by the fluid on solid bodies are determined to be linearly proportional to the acceleration of the vibrating solid bodies; i.e., the presence of the fluid only affects the inertia of the solid body system. A finite element computer program has been developed for computing this hydrodynamic (or added) mass effect. This program can be used to determine the hydrodynamic mass of a two-dimensional fluid field with solid bodies of arbitrary geometry. Triangular elements and linear pressure interpolation function are used to discretize the fluid region. The component element method is used to determine the dynamic response of the multibody system to externally applied mechanical loading or support excitation. In the component element method, each structural body is modeled by component elements of conceptual spring-damper type. This method is particularly advantageous for systems having nonlinearities. Direct timewise numerical integration scheme is used to solve the governing dynamic equation of the system. Analytical study is carried out and compared with an experimental result for the forced vibration of 4 simply supported beams in water. Also studied is a case of 25 (5x5) beams within a square fluid-filled container by using two different approaches.

54917 (INIS-mf—4638, pp vp) **Novel technique for calculating fluiddynamic phenomena with respect to structural feedback.** 1977. **(In** German).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The investigation of strongly transient fluid dynamic phenomena requires a consideration of flexible walls. This occurs particularly in nuclear power plant safety problems, e.g. in the field of blowdown simulations. For the solution of the problems outlined above a method is proposed which uses two separate codes, one for the structure and one for the fluid. Thus, the advantages of both methods, which may base on completely different methods, can be inserted into the calculation. On the one hand a finite element structural code is used, on the other hand a one-dimensional flow model (including pressure wave and thermodynamic non-equilibrium effects) is utilized, which is also applicable for a calculation of two- and three-dimensional fluid problems by introducing a mesh of one-dimensional fluid channels. The fluiddynamic part of the realized code consists mainly of the code DAPSY, which is a further development of the code BLAST. The setting up of the partial differential equations is performed in Eulerian coordinates and the integration is accomplished by the method of characteristics. The structure dynamics part consists of a finite element code, which has to be able to calculate time varing pressure load, momentum and wall friction forces. Up to now, only few commercial finite element codes compute time varying pressure loads, but there are no great difficulties to establish this possibility additionally. The structure codes SAPIV and ASKA were used to deliver the structure system matrices. To assure a simultaneous existence of the fluid and structure equations, it is necessary to introduce a coupling part, which organizes the data exchange.

54918 (INIS-mf—4638, pp vp) **Finite-element analysis of two-phase flows.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

It is of importance to predict the time history of the depressurization that follows a loss of coolant accident to guarantee the integrity of the overall system. In this report the sudden depressurization of a straight pipe filled with heated and compressed water is investigated. This condition is isolated from a complicated sequence of events triggered by a loss of coolant in a water cooled reactor. The investigated water column contained in a straight section of pipe is released suddenly at one end. After a quick initial pressure drop, vaporization occurs. At this point, the rate of depressurization becomes much lower. The pressure inside the pipe is now controlled by the rate at which the steamwater mixture escapes through the

open end. This investigation represents the first attempt to employ a direct stiffness finite-element approach to the solution of the depressurization of a straight pipe. The MARC Nonlinear Finite Element Analysis program provided the necessary software capabilities. The section of the pipe is represented by a number of one-dimensional finite-elements connected in series. Due to the large range covered by the full expansion of the compressed water to a steam-water mixture at ambient conditions, large displacement and large strain effects are considered in the problem formulation. Best suited for finite-element application of this scope is the Lagrangian approach where the variables of the current state are expressed in terms of the original reference state. The stress and strain measures are those of Piola-Kirchhoff and Green. A suitable constitutive law is generated from steam table data. The equations of motion are integrated by means of the Newmark-Beta method. The pronounced nonlinearities in geometry and material present no difficulties for this solution method.

54919 (INIS-mf—4638, pp vp) **Full-scale HDR blowdown experiments as a tool for investigating dynamic fluid-structural coupling.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

As an answer to rigorous safety requirements in reactor technology an experimental-theoretical program has been established to investigate safety-relevant mechanical aspects of LWR-blowdown accidents. Part of the program are several full-scale blowdown experiments which will be performed in the former HDR-reactor. As the conceptional study confirms, the primary goal is to find out, how big the safety margins of present LWR's in the case of a blowdown actually are, rather than simply to show that essentional parts of the reactor will withstand such an accident. The experimental program is accompanied by the development of theoretical models and computer codes. Studies carried through so far indicate, that the dynamic coupling between the expanding coolant and the deforming core barrel within a time region, where the coolant remains in the liquid phase, presents the key problem. Consequently, design of the full-scale blowdown experiments is done in such a way as to give information on this subject of (three-dimensional) fluid structural coupling, rather than giving informations on structural details which are unessential for the overall problem and which may change from one reactor type to another. A core barrel wall thickness of 23 mm is used with an almost rigid core barrel clamping. The following approaches are used: coupling of an existing finite difference-code for 2D compressible fluid flow (modified YAQUI) with a core for shell dynamics based on modal superposition; specific finite difference-code for integrated treatment of both fluid and structure in 3D-geometry using the fast cyclic reduction scheme for solving Poisson's equation; modification of mass and stiffness matrices of FEM-models for shell dynamics by reducing the 3D incompressible fluid problem to 2D with the boundary integral equation method.

54920 (INIS-mf—4638, pp vp) **Three-dimensional BWR suppression pool seismic sloshing analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54921 (INIS-mf—4638, pp vp) **Transient response of structural components to unsteady flow impact and drag loads in a BWR suppression chamber.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54922 (INIS-mf—4638, pp vp) **Vertical forces induced in a 1/5 scale MARK I BWR toroidal wetwell under LOCA conditions.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54923 (INIS-mf—4638, pp vp) **Hydro-elastic calculations of the dynamic response of a reactor to a sudden loss of coolant.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54924 (INIS-mf—4638, pp vp) **Calculation of hydrodynamic structural interactions in the subcooled blowdown of a pressurized water reactor.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54925 (INIS-mf—4638, pp vp) **Coupled structure-fluid analysis for a PWR burst protection design.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The burst protection designed to withstand hypothetical ruptures which might occur in certain components of the primary circuit including RPV (reactor pressure vessel) rupture mainly consists of cylindrical concrete vessels for the RPV and the steam generators and steel tubing for the primary pipes. A hypothetical RPV failure will result in direct excitation of single components and will lead to complex interactions between all components of the protecting structures, the primary loop, reactor core, core support structures and the coolant. The overall investigations to determine the magnitude of deformations and stresses are summaized. Economical aspects with respect to the investigations are treated biefly. The coupled structure-fluid analysis of the core and core support structure due to horizontal and vertical RPV failure will be presented in detail. Assumptions for the RPV failure modes include vertical, horizontal and screw-shaped rupture of the RPV, the detachment of RPV nozzle as well as other types of failure. On the basis of the failure modes, types of credible extremal load conditions were estimated. For vertical RPV failure modes, loads were applied to a global beam-model consisting of burst protection and primary loop structures. Nonlinear coupling between structural parts was taken into account. The nonsymmetric boundary conditions were taken into account by Fourier-expansion in circumferential direction. The mathematical solution is based on the governing equations for pressure wave propagation in fluids and vibrations in solids. Horizontal rupture of the RPV was assumed to occur in the welding connecting spherical bottom and cylinder. Inertia terms of the fluid were incorporated in the equations of the system.

54926 (INIS-mf—4638, pp vp) **Experimental studies of PWR safety injection branch flow.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The safety injection water, injected through the auxiliary piping in the primary circuit of pessurized water reactors, may be at a temperature significantly different from that of the primary fluid. Some fatigue analyses have shown that it is necessary to install thermal sleeves for protecting nozzles against cyclic thermal stresses. Moreover, the primary flow can induce vibrations at a level which can have a detrimental effect on the thermal sleeve. This paper shows the results of an experimental study performed by Framatome, which presents both the thermal efficiency and the vibration behavior of thermal sleeves. Two reduced scale models (1/5) of a 12" size nozzle have been tested. One nozzle is perpendicular to the main circuit, the other inclined at 45°. Some of the conclusions of this study are presented: pressure fluctuations and thermal sleeve displacement during normal operation (without safety injection) can induce low frequency reactor coolant flow turbulence inside the nozzle. This turbulence effect was also measured under low safety injection flow conditions; the mixing of primary fluid with injected fluid is improved in the case of the perpendicular nozzle configuration; during safety injection, the pimary piping is more thermally affected if the injection is made through the 45° inclined nozzle. This study points out, in the case of 45° nozzle, the necessity of having a thermal sleeve, to protect the nozzle against thermal stress and to ensure a good vibration behavior.

54927 (INIS-mf—4638, pp vp) **Computer code SEURBNUK-2 for fast reactor explosion containment safety studies.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The paper describes the theory and capabilities of the SEURBNUK-2 fluid flow code developed by JRC Ispra and AWRE Aldermaston for use in containment analysis for fast reactor explosion containment studies. It is a 2D Eulerian code and is a major extension of the SURBOUM code developed earlier by Belgonucleaire and Aldermaston. SEURBNUK-2 has a full thin shell treatment for tanks of arbitrary shape and is able to include the effects of compessibility of the fluid. Viscosity and diffusion are neglected and a purely implicit time centred difference scheme adopted. Results are presented from a SEURBNUK calculation for the Ispra test shot 114 of the expansion of a Belgonucleaire charge in an overstrong water filled vessel. Thin shells are treated by a full bending theory and may be of general shape. Their positions in the program are given by a series of Lagrangian marker particles which are allowed to move through the fixed Eulerian fluid grid as the shells deform. The shells are divided into a number of sublayers each of which is assumed to behave as a perfectly plastic material but with a different yield stress. Comparisons have been made of the effect of using a full bending theory for the tank as opposed to a simple membrane treatment. It is shown that the inclusion of bending terms does not alter the ultimate strains significantly but it does lead to much smoother results for the values of the stress components in the wall. Results are also presented for calculations on a U-shaped tank containing fluid with a cover gas simulating a bare primary tank. Three different calculations have been done involving rigid and flexible tanks and an incompressible and compressible treatment for the water.

54928 (INIS-mf—4638, pp vp) **Lagrangian and Eulerian finite element techniques for transient fluid-structure interaction problems.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The basic finite element equations for transient compressible fluid flow are presented in a form that allows the elements to be moved with the fluid in normal Lagrangian fashion, to be held fixed

in a Eulerian manner, or to be moved in some arbitrarily specified way. The co-existence of Lagrangian and Eulerian regions within the finite element mesh will permit to handle greater distortions in the fluid motion than would be allowed by a purely Lagrangian method, with more resolution than is afforded by a purely Eulerian method. To achieve a mixed formulation, the conservation statements of mass, momentum and energy are expressed in integral form over a reference volume whose surface may be moving with an arbitrarily prescribed velocity. Direct use can be made of the integral forms of the mass and energy equations to adjust the element density and specific internal energy. The Galerkin process is employed to formulate a variational statement associated with the momentum equation. The difficulties associated with the presence of convective terms in the conservation equations are handled by expressing transports of mass, momentum and energy terms of intermediate velocities derived at each cycle from the previous cycle velocities and accelerations. The hydrodynamic elements presented are triangles, quadrilaterals with constant pressure and density. The finite element equations associated with these elements are described in the necessary detail. Numerical results are presented based on purely Lagrangian, purely Eulerian and mixed formulations. Simple problems with analytic solution are solved first to show the validity and accuracy of the proposed mixed finite element formulation. Then, practical problems are illustrated in the field of fast reactor safety analysis.

54929 (INIS-mf—4639) **Seismic risk analysis for canadian nuclear power plants.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A general formulation for seismic risk analysis of nuclear power plants sited in Canada is presented. The study identifies the important parameters by sensitivity analyses and draws certain conclusions regarding their importance for risk. The formulation allows the use of various forms of probabilistic description of the resistance. Analyses are presented for lognormal, uniform natural logarithms and uniform probability distribution for the resistance and it is shown that the total risk is insensitive to the actual distribution in the ranges of interest. Two measures of seismic risk are discussed, the total seismic risk and the risk due to the DBE only. Typical values for each are computed and comparisons show that the former is relatively insensitive to design decisions and may be as high as 10^{-5} while the latter is very sensitive and may be as low as 10^{-12}. The safety index β is used as the measure of the design basis. A Bayesian approach is proposed for treatment of uncertainty in the parameters. The effects of other loads on seismic risk is studied and it is shown that inconsistencies exist in the overall factor of safety and the systems designed primarily for seismic loads have the least probability of survival.

54930 (INIS-mf—4639) **Determination of support spacing tables used in the design of safety class nuclear plant piping.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54931 (INIS-mf—4639) **Subharmonic excitation in an HTGR core.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The occurrence of subharmonic resonance in a series of seven blocks with clearance gaps between blocks and with springs and clearance on the outermost ends is considered. The clearance between each block could be the same or different. Spring packs are installed between the first and last block and the input motion. The system non-linearity is due to the severe discontinuity on the interblock elastic forces when adjacent blocks collide and to the clearance that is present between the outermost springs and the core elements. A computer program using a numerical integration scheme was developed to solve the response of the system to arbitrary inputs. Sweeping both up and down with sinusoidal excitation on this system shows the non-linearity in the response behavior. When the frequency was increased it was found that a second order subharmonic was easily developed. This was not expected because of the symmetry in the system. This occurred when the forcing frequency was two times the first resonant frequency and very much below the second resonant fequency. Because of the bending of the response curve, the effect of the subharmonic occurs over a broad range. The magnitude of the response due to the subharmonic is smaller than the primary resonance. Nevertheless, it is an added factor in the peak response of the system. More importantly the occurrence of the subharmonic means that substantial response might be expected of the system regardless of the frequency content of the excitation spectrum. In the non-linear core of the HTGR, a response peak could occur even though the forcing frequency is above what might be considered as the natural frequency of the system. In addition, for more than one sine wave input, which is generally the case, the occurrence of a subharmonic means that large amplitudes can develop where the response is remarkably greater than the sum of the separate contributions of the components if they acted alone.

54932 (INIS-mf—4639) **Seismic behavior of reactor internals.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54933 (INIS-mf—4639) **Seismic instrumentation for NPP - An interpretative review of current practice and the related standard in Germany.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54934 (INIS-mf—4639) **Seismic analysis of category I overhead cranes considering structural non-linearities.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54935 (INIS-mf—4639) **Dynamic analysis of electric equipment for nuclear power stations under seismic loads.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The response spectrum method, generally accepted as the most practical method for linear seismic analysis of power station components, is here applied in conjunction with the finite element method to electric components. The fully dynamic analysis based on the superposition of the natural modes as carried out for an electronics cabinet and for transmitter supports is outlined and selected results are presented. Several different methods are in use for the superposition of the contributions of the different modes. Here addition of absolute values, the square-root of the sum of squares, and a mixed method taking account of closely spaced modes is applied. For different structures, the degree of conservativity is thus demonstrated, the largest difference in the stresses computed by the different methods being approximately 30%. For structures whose natural frequencies are in the spectrum range with zero period response, a simplified response analysis using static loads is often carried out. This is demonstrated for the electronics cabinet and transmitter mountings, and the results are compared with the fully dynamic analyses. It is seen that this 'pseudo-dynamic' analysis yields useful approximations for the distributions of stresses. Practical details of the structural models as well as results are presented for several switchgear and electronics cabinets.

54936 (INIS-mf—4639) **In situ dynamic tests and seismic records on the RHR system building ENEL IV nuclear plant, Caorso (Italy).** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54937 (INIS-mf—4639) **Modal dynamic analysis of linear elastic systems with specified displacement time histories.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54938 (INIS-mf—4639) **Seismic response of flexible cylindrical tanks.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

An experimental study of the seismic behavior of thin shell circular cylindrical liquid storage tanks is described. The investigation was planned to evaluate the adequacy of present methods of tank design, and was conducted using the Earthquake Simulator Facility of the University of California, Berkeley. The model tank considered in this paper was 6 ft high by 12 ft in diameter, and was welded from thin sheet aluminum to simulate a steel tank 36 feet in diameter. During testing the tank had an open top, held 60 inches of water, and was subjected to a time scaled El Centro (1940) earthquake, amplified to a peak acceleration of 0.5 g. Both base free and base fixed conditions were studied. Results of the experiments demonstrate that fluid pressures included both impulsive and convective

components, and that the wave sloshing followed basic theory quite closely. But it also was apparent that the tank flexibility influenced the hydrodynamic pressures, as indicated by pressure amplification in the clamped tank, and by a total change of pressure history in the unclamped case. Significant out of round distortions of the tank were developed, of a three lobe form or the free base case and with four lobes in the fixed base case. Uplift of the tank base was closely related to the out-of-round deformation of the unanchored tank, whereas initial eccentricities apparently caused the section distortions in the anchored system. Stresses in the tank wall do not follow the expected pattern of response to overturning moment; instead they seem to be mainly associated with the section distortions. At present there is no analytical procedure for predicting these distortions .

54939 (INIS-mf—4639) **Effect of damping on the response of a non-linear system with multiple sine wave excitation.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Sine wave sweep tests are commonly used to evaluate the dynamic characteristics or to simulate the shock testing to a response spectrum of linear and non-linear systems. This paper shows that large differences can occur in the dynamic response of a cubic non-linear system if even a small amount of a second sinusoidal term appears in the excitation. That is, small responses are obtained if the system is excited with either term applied separately. However, when the combination is applied, large responses can develop. The cubic non-linearity is used as a first analytical form of a system with clearance gaps between masses, such as an HTGR core. The paper discusses, in particular, the effect of damping on the critical lock-on value of the excitation for a subharmonic oscillation to develop.

54940 (INIS-mf—4639) **Experimental test results and theoretical dynamic analysis of the PEC fast reactor shutdown system during a S.S.E.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54941 (INIS-mf—4639) **Seismic design for steam generators. A multiple system approach.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Certain class of nuclear power stations such as CANDU-PHW plants have multiple reactor coolant systems. The typical CANDU 600MW(e) plant has 4 such systems functioning within each reactor building, with the major components in each coolant loop being the steam generator. These steam generators are clustered about the reactor and are supported independently, but in similar fashion by the boiler room floor. Although the component steam generators were designed as identical units, it was found that differences in operating conditions and variations in lateral supports caused a detuning effect between the 4 generators, with a consequent decrease in the effective mass ratio and an increase in response. It is the purpose of this paper to extend the concept of mass ratio to multiple system installations. Guided by the results of the parametric study, it was concluded that the coupled building/steam generator analysis, carried out on only one system, with the weight of the remaining three systems lumped into the building structure, would provide conservative but reasonable results; whereas, an analysis modelling all 4 systems would not only lead to a more extensive and complicated analysis but would also underestimate the response. A description of the coupled analysis and representative results of the steam generator accelerations and displacement are presented in the paper.

54942 (INIS-mf—4639) **Seismic qualification of systems, structures, equipment and components.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this paper is to give an overview of the various qualification procedures available to the vendors of nuclear power plants and equipment for hopefully achieving NRC (Nuclear Regulatory Commission) plant licensing and overall guaranteed safe operation. These procedures usually involve computer-aided analyses for large systems and structures, but trend toward shaking table tests for small equipments and components. For example, analysis is used to investigate primary piping loops where calculated stresses are the criteria for failure. On the other hand, testing of sensitive devices becomes necessary where the avoidance of conceivable malfunctions is the criterion for safe performance.

54943 (INIS-mf—4639) **Approximate seismic response analysis of self-supported thin cylindrical liquid storage tanks.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

To make an accurate analysis of the seismic responses of tall thin tanks it is assumed that the motions of the liquid in the tank would be in accordance with the velocity potential theory and derived a method of approximate analysis of their seismic effects which was applicable to both the liquid-tank coupled vibration system and the sloshing vibration system. That is, as to the behavior between liquid and tank under earthquake, seismic response analysis was devided into the following two cases. In the first seismic load is evaluated in regard to coupled vibration system between liquid and tank, liquid surface oscillation is neglected and pressure fluctuation of liquid is considered as virtual mass to the tank wall, when its deflection is taken into consideration. In the second seismic load is evaluated in regard to sloshing vibration system, only pressure fluctuations by liquid surface oscillation is considered supposing that the tank wall is rigid. It is proposed that the tank total seismic responses of thin wall tank containing liquid are obtained by adding these both seismic response. Furthermore, to investigate the appropriateness of this analytical method, it is made a reduced-scale plastic model of a cylindrical tank and obtained the vibration characteristics and seismic response characteristics of the model by using a shaking table. The experimental values showed a good agreement with their respective theoretical values, proving the appropriateness of the analytical method.

54944 (INIS-mf—4639) **Dynamic structural analysis of uncoupled subsystems.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper presents the results of an investigation of dynamic seismic analyses of complex uncoupled substructures. The techniques used and conclusions obtained are applicable in general for any system/subsystem configuration. A nuclear power plant primary building structure and a pressurized water reactor coolant system are used as the system/subsystem examples. Methods of analysis are discussed and typical results are presented.

54945 (INIS-mf—4639) **Comparison of vibration tests and analysis on nuclear power plant structures and piping.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper presents the analysis and testing methods, selected theoretical and experimental results, and comparisons of these results for a series of ambient, forced vibration, snapback, and low-level explosive tests performed on the Heissdampfreaktor (HDR). These tests and theoretical analyses were used to determine the dynamic characteristics and response of the reactor containment structure and several piping system under simulated seismic excitation. The dynamic characteristics of the facility which were identified by the experimental tests are those that are of significant importance in terms of resistance to seismic forces and other earthquake engineering considerations. The primary concern was the identification of the critical eigenfrequencies, modal deformations, and damping values of each structural system tested. Finite element techniques were employed to determine the eigenparameters and response to sinusoidal forced vibration testing of a complex nuclear piping network comprising a representative section of the superheated-steam-saturated steam system at HDR. Modeling and testing techniques employed are described and analytic and experimental results are compared. Conclusions and recommendations are drawn from the results of the experimental tests and theoretical predictions relating to the analysis and design of nuclear power plants for earthquake interaction, analytical modeling techniques, calculation and identification of critical damping values, identification of primary system modes, and improved methods of full-scale dynamic testing. A summary of the major findings, conclusions and recommendations is presented.

54946 (INIS-mf—4639) **Rational and economical seismic design of beam columns in steel frames.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In the present study, a new rational procedure is used in which simultaneous variation in various response quantities is predicted. For designing the beam column section according to the AISC Manual of Steel Construction, one has to know the values of the axial force, the moment about x and y axes at the two ends, and the maximum moments about x, y axes near the center of the beam column, which altogether constitutes seven response quantities of

interest for each beam column element. Normally, seven equivalent modes will be required to represent the response. However, by designing the two end sections and the intermediate section independently one can consider three equivalent modes for each section, thus simplifying the problem a great deal. An existing computer program is used for the implementation of the proposed method. Results for typical example problems have been presented. It is shown that savings up to 42% in the steel cross-sectional area can be obtained depending upon combination of various forces and moments. The propposed method is 'exact' within the existing assumptions of the SRSS (square root of the sum of the squares) or the double sum method.

54947 (INIS-mf—4639) **Dynamic behavior of a nuclear reactor building.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Forced vibration tests were performed on a nuclear reactor building to investigate its dynamic characteristics. Tests were made on two orthogonal directions, one was parallel where a stack 50 m-high was located at 50 m distance from the reactor building, another was perpendicular. Two close resonant frequencies were obtained from a resonant curve of the parallel direction, 5.1 Hz and 5.9 Hz, while one was obtained on the perpendicular direction, 5.1 Hz. Critical damping values were from 15 to 18%. The displacement was mainly caused by rocking vibration and deformation of the building was small. Attempts were made to correlate the experimental results with finite element models that included the building-soil-stack system. It was found as the result that the frequency 5.1 Hz was a natural frequency of the building-soil system and the 5.9 Hz was one of the ground, and at these frequencies two peaks were produced on the parallel direction for the reason that the vibration decreased between the two frequencies under the coupling effect of the 2nd vibration of the stack, while the coupling effect was negligible on the perpendicular direction. In conclusion, both the experimental and analytical work indicate that the effect of structure-soil-structure interaction should be considered for the prediction of the seismic response and finite element model can be a useful method.

54948 (INIS-mf—4639) **Design errors and system degradation in seismic safety.** Jaeger, T.A.; Boley, B.A. (comps.). (Commission of the European Communities, Brussels (Belgium)). 1977. vp. (CONF-770807—(Pt.Kb)).

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this paper an estimate of the possible number and influence of seismic-related design errors is obtained by examining the historic record of such errors for a specific reactor and assuming that, with inclusion of a factor to represent a learning curve, this record would be representative of other reactors. The historic errors were divided into three categories; major, considerable and moderate. About twenty of each of the first two categories were found. The range of undiscovered seismic design errors was estimated, and Newmark's safety factor was reduced proportionately depending on the seriousness of the design error. It was assumed that at least ten failure paths exist, rather than the single path assumed in WASH-1400; also it was estimated that for some failure paths (e.g., liquefaction) the original safety margin would be much less than 20. Also, a closely coupled failure in redundant systems from seismic events was assumed. Using the same relationship between recurrence frequency and acceleration as used in WASH-1400, the probability of severe core damage from seismic events was then estimated to be between 8×10^{-5} and 8×10^{-4} per reactor year. While the absolute values obtained are subject to large error and uncertainty, they are substantially larger than the values obtained in WASH-1400, and suggest further study is needed. The number of cycles to failure of a pipe undergoing about 100 plastic cycles due to a severe earthquake was related to original flow size using a crude method based on measurements by Cherepanov. As an example of the results, it was found that for flaws initially about 1 inch in size, fifty cycles having about 1% plastic strain might cause failure.

54949 (INIS-mf—4639, pp vp) **In-situ testing for seismic evaluation of Humboldt Bay nuclear power plant for Pacific Gas and Electric Company.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In-situ vibration testing was used to supplement theoretical analysis of selected storage tanks, pumps, motors, valves, electrical cabinets, instrumentation, piping, and major structures. These techniques proved useful in providing damping values, confirmation of theoretical models, development of models of exceedingly complex structures, and, to a limited extent, for in-situ proof testing. Seismic upgrading of several structures was subsequently performed. Five case studies are discussed in this paper. In each case, physical description, reasons for requiring tests, testing performed, and use of test data to aid analysis is given. Case one is a Liquid Poison Tank, the testing of which was used to simplify the model of the existing tank and define stiffness properties for use in the analysis. Case two discusses the high level in-situ proof testing of an emergency generator. Case three test results, for the Reactor Control Board, indicated the need to stiffen several panels and provided the necessary information for the development of a model which was used to predict input spectra for selected instruments mounted on the panel. Certain of these instruments were subsequently shake-table tested by others according to the developed spectra. The fourth case involves a 250-ft ventilation stack. Test data were used to verify the analysis of the stack. The final case concerns testing of the control room floor. Test results pointed out the need for structural modification. The basic conclusion of this paper is that in-situ testing is a feasible and useful method to improve and guide theoretical studies and seismic design of nuclear power plant equipment and structures.

54950 (INIS-mf—4639, pp vp) **Seismic analysis of nuclear power plant components subjected to multi-excitations of earthquakes.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this analysis, the modal analysis methods are used to determine the seismic responses of structural systems instead of the direct integration method. These results have been compared with some other analytical methods, and investigated the accuracy of numerical results of these analysis, applying to such components as Reactor Pressure Vessel and Reactor Internals of an actual plant. The results of this method of analysis are summarized as follows: (1) one of the seismic analysis methods concerning systems subjected to multi-excitations of earthquakes has been presented to the conference of JSME. Although the analytical theory presented to that conference is correct, it has a serious problem about the accuracy of numerical results. This computer program and theory cannot be used practically due to the time necessary to calculate. However, the method described in this paper overcomes those serious problems stated above and has no problem about the computer time and precision. So, it is possible to apply this method to the seismic design of an actual nuclear power plant. (2) The feed back effects of the seismic responses of Reactor Internals to Reactor Building are considered so small that we can separate the model of Reactor Internals from Reactor Building. (3) The results of seismic response of Reactor Internals are fairly consistent with those obtained from the model coupled with the Reactor Building. (4) This analysis method can be extended to the model of Reactor Internals subjected to more than two random excitations of earthquakes. (5) It is possible that this analysis method is also applied to the seismic analysis of such three-dimensional systems as piping systems subjected to multi-excitations of earthquakes.

54951 (INIS-mf—4639, pp vp) **Basic study on seismic response of HTR core.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Some basic experimental investigations and computer analyses have been carried out in series to evaluate the aseismic properties of block type HTR graphite fuel assembly. Rational simplifications has been taken to develop the theoretical model, and checked by means of corresponding experimental set-ups. Followings are major findings through consequential efforts up to date, which would be useful information for preliminary design of the core. (1) The loosely assembled core blocks oscillate as a lumped mass between boundaries with frequency of forced vibration. This characteristics is concluded by the observation of simple lumping action in one-dimensional and in horizontal section model, and in parallel bowing motion of double columns. (2) There is the possibility that properties in horizontal section model can be treated similar to in one-dimensional problem. (3) A column has non-linear 'spring' property in its restoring force against horizontal displacement and this causes non-linear resonance. The multiplication effect of this resonance is now under investigation. (4) Simple empirical formula is derived to describe the multiplication factor of acceleration (ratio of impact acceleration to input acceleration) of individual blocks in one-dimensional model. (5) Analytical results on impact accelerations of blocks in one-dimensional assembly shows good agreement when the result of additional collision experiment on a pair of graphite blocks is applied. (6) Collision tests are also conducted to evaluate the scale effect on full sized, 1/2 and 1/5 scale blocks with collision velocity up to 150 cm/s. Substantially the same values of coefficient of restitution are obtained, and all the blocks remained free from any damage through these experiments.

54952 (INIS-mf—4639, pp vp) **Seismic qualification of safety related electrical equipment - Latest methods that meet IEEE-344-75.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54953 (INIS-mf—4639, pp vp) **Aseismic foundation system for nuclear power stations.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The aseismic foundation system, as described in this paper, is a new development, which makes it possible to build standard nuclear power stations in areas exposed to strong earthquakes. The principle consists in interposing a device between the buildings of the nuclear island and the foundation soil which limits the value of the horizontal acceleration in the nuclear island buildings. The nuclear island foundations consists of a double raft with aseismic bearings interposed between the upper and lower raft. These bearings are placed on top of short concrete pedestals constructed on the lower raft. The space thus provided between the two rafts allows access to the bearings. The bearing consists of two parts: a block of reinforced elastomer, a set of friction plates such as stainless steel+bronze with lead. The reinforced neoprene pad acts as a soft horizontal spring imparting a first mode of translation to the structure with the frequency of about 1 c.p.s. depending only on the characteristics of the bearing. As this first mode is predominant, the value of horizontal accelerations at each level for all buildings are almost identical. The above mentioned frequency has been selected in order to be outside the range of natural frequencies of the buildings themselves and of the frequency of the equipment. The friction plates due to their nature and surface treatment permit to ensure a consistent value of the coefficient of friction 'f' so as to limit the maximum horizontal earthquake forces to values close to fxg. Under a low level earthquake (0.15 g-0.20 g) the structure vibrates and returns to its original position. The temporary relative displacement during such an earthquake can reach about 0.10 m. Under an earthquake of higher level (up to 0.60 g) the vibrating structure slides on the friction plates. The complete detailed design together with experimental evidence have shown that the system is operational.

54954 (INIS-mf—4639, pp vp) **Seismic response of flexible cylindrical liquid storage tanks.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Liquid slosh and tank wall vibrations are studied experimentally in a flexible model storage tank subject to simulated earthquake environments. A similitude study is first performed to develop the important nondimensional parameters. An aluminum model tank of 62.87 cm diameter, 76.2 cm height, and 0.51 mm wall thickness, having flat rigid bottom and top cover is instrumented to measure liquid slosh amplitudes and pressures, and tank wall vibrations and strains. Simulation of a scaled earthquake environment is provided by a biaxial shake table having the capability of simultaneous independent horizontal and vertical excitation. Ground motion time histories are developed from random signals, and are modified to produce specified different earthquake response spectra along each axis. It is found that liquid slosh amplitudes are principally related to horizontal seismic displacements, while pressures and shell wall flexural vibrations are principally related to both horizontal and vertical seismic accelerations. Wall vibrations and strains are found to be as sensitive to vertical accelerations as they are to horizontal accelerations. The wall response is comprised principally of the first several flexural or breathing modes which have multiple waves around the shell circumference. Influence of vertical excitation on this type response is surmised to occur through either geometric eccentricities or through parametric excitation mechanisms. Shell wall responses damp out rapidly after the seismic event has subsided. However, low frequency liquid slosh persists for a long time duration after the seismic event. By comparison with predictions from a simple analytical model, liquid pressures are separated into impulsive, or acceleration loads, and convective, or slosh loads. The simple analytical model is shown to be inadequate for certain parameter ranges and earthquake conditions. Explanations for the discrepancies are offered.

54955 (INIS-mf—4639, pp vp) **OSCIL and OSCVERT: computer codes to evaluate the non-linear seismic response of an HTGR core.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

OSCIL and OSCVERT are FORTRAN codes which simulate the effects of seismic input on a High Temperature Gas Cooled Reactor (HTGR) core. The analysis, in conjunction with results of experimental scale models, is to be used to determine safety standards and licensing regulations for HTGR. Much interest has been felt in seismic analysis due to the obvious hazards. OSCIL models the core as a horizontal one-dimensional non-linear spring-mass system with friction. OSCVERT is the two-dimensional extension, with each mass in OSCIL expanded to a vertical column of blocks. An important feature of OSCVERT is that large rotations are allowed. The codes use a powerful integration scheme due to GEAR. This permits very stiff springs, as well as transients ('jump' phenomena)) due to multiple solutions that arise in non-linear systems, to be incorporated in the codes. Either code can be used more generally to analyze the non-linear dynamic response of a spring-mass system excited by boundary motions.

54956 (INIS-mf—4639, pp vp) **Seismic response of a stacked HTGR fuel column interacting with a control rod.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A theoretical investigation has been conducted to study the dynamic interaction between a HTGR fuel column and an inserted control rod when the system is excited by boundary motion due to earthquake disturbances. The mathematical model developed simulates a control rod structure inserted at varying depths into the channel of a fuel column. The control rod is modeled as a series of rigid masses with flexible contact points representing the canisters which are interconnected by spherical ball joints. The fuel column consists of a series of stacked graphite blocks constrained by dowel pins. Therefore, the interaction model was established by coupling an existing stacked column model with a control rod model which was separately developed. The column-rod interaction analysis was performed by coupling the chain-type model of the control rod with the mathematical model of a stacked column through the phenomenon of impact. The geometrical length of the control rod canister is designed in such a way that the canisters are always staggered with respect to the fuel blocks, irrespective of rod insertion position. A feature of the present analysis is that the coordinates for the contact nodes where impact forces are generated are not fixed but rather internally assigned by the computer according to the insertion position specified and, consequently, an arbitrary insertion depth can be considered. The numerical results show variations of seismic response of the system with respect to the insertion depth and other parameters. An inserted control rod was found to act as an efficient impact damper wich attenuates the column response.

54957 (INIS-mf—4639, pp vp) **Analysis of high frequency and multiple-support excitation problems with KWUROHR.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54958 (INIS-mf—4639, pp vp) **Seismic response of flexible liquid containers.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of this work is to demonstrate that the errors introduced by the assumption that the container is rigid could be avoided in practical design, since they may not be on the conservative side. Indeed, the flexibility of the container should not be ignored in cases where the structural period (say 0.10 s) corresponds to a 'peak' in the response spectra. On the other hand, these errors may yield excessively conservative results. In the method described herein the effects of liquid damping, in the order of 1/2%, is neglected. Effects of sloshing (non-horizontal free surface) and liquid compressibility are accounted for. A practical analysis procedure is presented based on the solution of the two dimensional wave equation for the liquid, with time dependent boundary conditions, imposed by the dynamic response of the flexible container walls. The liquid and the walls are allowed to iteratively interact until the final common frequencies and hydrodynamic pressures are obtained. The method while still approximate is superior to other such methods where accounting for flexibility is important. It is also generally applicable to containers of any practical shape and structure, as standard dynamic analysis procedures can be applied iteratively. The procedure begins by finding the dynamic response in the absence of the liquid. The frequency and displacement of each mode are used in the time dependent boundary condition in solving the wave equation for the liquid. A pressure function is then obtained and converted to an equivalent mass, which is used to correct the displacement shape and frequency. The process is repeated until no significant correction of the frequency is found. The implementation is done on an open rectangular tank, containing water. Four different cases of analysis are presented, accounting for sloshing and compressibility.

54959 (INIS-mf—4639, pp vp) **Instantaneous response spectrum in seismic testing of nuclear power plant equipment.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper presents the concept of instantaneous response spectrum (IRS) as the response of single degree of freedom oscillators at a particular time. It demonstrates that a shake table random motion whose standard TRS envelops the RRS does not necessarily satisfy the enveloping requirement instantaneously. That is, any one (or more) instantaneous required response spectrum (IRRS) is not enveloped by any instantaneous test response spectrum (ITRS). Response spectra from different time histories, including single frequency sine beat motion used in resonance testing, are compared for enveloping with maximum response and with the actual response at particular times. These comparisons are given for the enveloping of RRS and IRRS derived with a time history response calculated at a particular building elevation of a nuclear power plant. For the test motion, several of the most severe ITRS derived with a modified EL Centro motion and with a sine beat motion with ten cycles per beat were used. It is shown that although the TRS with the modified EL Centro motion enveloped the given RRS, the selected modified EL

Centro ITRS did not envelop the corresponding IRRS. With the sine beat motion, even though the TRS did not fully envelop the given RRS, the resulting sine beat ITRS did not require a larger factor for full IRRS enveloping than those of the modified EL Centro motion.

54960 (INIS-mf—4639, pp vp) **Objectives of seismic tests in the HDR safeguards research program.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The studies being performed on the HDR are intended to verify and, if necessary, optimize with respect to earthquake effects the methods of computation for the dynamic analysis of reactor pressure vessel, piping systems, soil, equipment and fluids. The program is divided into two parts: phase I 'low excitation level', and phase II 'high excitation level'. Phase I is characterized by the fact that mainly a linear vibration behavior is investigated experimentally with the stresses in the structures largely remaining in the elastic range. The results of the experimental studies of phase I are available for comparison with the results of theoretical studies carried out by means of the usual linear models. Phase II relates mainly to the assessment of the non-linear vibration behavior of the structures. The experimental studies are planned to go beyond the range of purely elastic material behavior. For this reason, it may be necessary in these theoretical studies to use computer models, or to develop new ones, which allow the treatment of non-linear material behavior and non-linear geometric effects. This becomes particularly important if non-linear effects have such significant consequences that an approximate assessment of the vibration behavior by linear methods will be no longer meaningful. The verification of methods and dynamic models by detailed comparison of calculated and experimental results is directed to: - the information about reliability of existing structural dynamic techniques and methods of measurement; the quantification of the influence of interactions between the soil and the containment structure and between the reactor pressure vessel or other circuit components and the pipes; the assignment of the techniques to their optimum fields of application; - the quantification of the influence on the vibration behavior of the parameters of materials, soil and design structure; - improved methods, especially for the assessment of non-linear effects.

54961 (INIS-mf—4639, pp vp) **Two-dimensional vibration test and simulation analysis for a vertical slice model of HTGR core.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper describes a two-dimensional vibration test and the simulation analysis for a vertical slice model of the General Atomic Company High Temperature Gas-Cooled Reactor (HTGR) core. The purpose is to clarify, through the experimental and analytical aspect, such dynamic properties as resonant characteristics and vibration modes of the core, lumping of block, collision pattern of blocks and distribution of reflector reactions. Forced vibration tests of a 1/5 scale model were performed by using a shaking table operated by an electric-hydaulic system in which both the horizontal and vertical excitations are simultaneously available. Two kinds of wave inputs were applied. The first ones are the stationary waves such as sinusoidal waves (0.1-0.5 g level, 1-10 Hz), and the second ones are the random waves such as El Centro, Taft and an artificial wave, with intensities of 0.1-0.5 g. A computer code called COLLAN 2-V was developed to mathematically simulate the test results. A new analytical technique is used in the code where the kinetic coordinates (x, y and theta) are expressed by complex numbers of plane vectors. It can be found that the mathematical results of inter-block displacements and reflector reactions coincide fairly with the experimental values. An animated film produced by means of a COM (Computer Output Microfilming) system is appended in order to catch visually the intricate block behaviors.

54962 (INIS-mf—4639, pp vp) **Preliminary seismic design of dynamically coupled structural systems.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this paper, the analysis criteria for coupling and decoupling, which are most commonly used in nuclear design practice, are briefly reviewed and a procedure outlined and demonstrated with examples. Next, a criterion judged to be practical for preliminary seismic design purposes is defined. Subsequently, a technique compatible with this criterion is suggested. A few examples are presented to test the proposed procedure for preliminary seismic design purposes. Limitations of the procedure are also discussed and finally, the more important conclusions are summarized.

54963 (INIS-mf—4639, pp vp) **Dynamic response of nuclear power plant due to earthquake ground motion and aircraft impact.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This paper examines both the indirect effect of aircraft crash and the effect of earthquake ground motions on the dynamic response of a single reactor nuclear island. The effect of gound properties on the dynamic response is investigated by varying the ground stiffness and damping over a range defined by the shear wave velocities 500 to 2000 m/sec. The effect of both the aircraft crash and the earthquake on the reactor plant can be compared directly by computing floor response spectra from the time-history response. The precise shape of the forcing function does significantly affect the response and consequently the floor response spectra. Peak floor response accelerations vary by up to 40% in the case of the MRCA and the effect of a variance on the prescribed aircraft impact forcing function should always be considered. However it is concluded that where nuclear facilities are being designed to ensure a safe shutdown against earthquakes, then provided the primary containment is designed to protect the primary reactor circuit against direct damage from a Multi Role Combat aircraft the reactor plant within the primary containment will have an acceptable response. In the event of a large aircraft such as the Boeing 707 crashing onto the facility, then the design of the reactor plant could be affected depending upon the amount of energy absorbed locally through direct damage.

54964 (INIS-mf—4639, pp vp) **Seismic model test of GCFR core support structure.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54965 (INIS-mf—4639, pp vp) **Measuring the seismic response of an HTGR core model.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The main objectives of this paper are to present (1) the new 1/5 scale full array core model instrumentation including design requirements, calibration and data reduction methods, (2) sample test results obtained with the new instrumentation, and (3) a comprehensive error analysis of the data. New test results are presented based on their significance to seismic qualification of the core. Core damping values of up to 40% were obtained from free and forced core vibration data utilizing new data reduction methods. The core phase angle response is presented. The core distribution of dowel pin forces and fuel element collision forces are also given including the load sharing characteristics of the dowels and the distribution of fuel element flat, adge and corner forces for a given earthquake input. The test data error analysis utilizes a flow chart to identify all systematic and random error sources within the test hardware and data acquisition systems. For the core boundary transducers subject to repeated testing, statistical analysis of the random error in the data is summarized which resulted in one standard deviation of less than 10%. For the relocatable incore instruments, an error model is formulated. The conclusions cover guidelines for design of the core instrumentation, including characterization of the HTGR core model response in terms of damping, resonance frequency, and the distribution of incore forces. Deviations in core model geometry and tranducer calibration data were ientified as the largest random error sources. Conclusions from the error analysis are directed at minimizing the data error in future seismic test programs.

54966 (INIS-mf—4639, pp vp) **Effect of clearance and distribution of mass on the dynamic response of an HTGR core.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Earthquake input motions to this type of core arrangement will result in multiple impacts between adjacent elements as well as between the reflector blocks and the restraining spring packs. The highly complex nonlinear response associated with the multiple collisions across the clearance gaps as well as with the spring packs is the subject matter of this paper. Of particular interest is the effect that variations in clearance and the choice of number of masses in the model have on the dynamic response of the HTGR core. To simulate the response of this system, a model using a single row, or slice, of horizonial elements was adopted for the dynamic investigations. Actual clearances as well as the total mass of a typical horizontal slice were used. The input motion was supplied by the horizontal displacement of the core vessel which in this case was chosen as a sine wave of constant amplitude. However, the frequency of the input was changed for each analysis. Interelemental elastic and damping coefficients were derived from the element geometry and material characteristics. Coefficient of restitution data was obtained from a model test using graphite. The viscous interelemental damping coefficients in the analytical model were adjusted to duplicate the energy dissipated during a collision in the model test. The viscous damping coefficients of the ground-motion dampers were evaluated on the basis that they would dissipate the same energy per cycle as ground friction. A computer program OSCIL, was developed to solve for the response of the system. Results show that when the mass systems are excited at their resonant frequency, all of the systems have similar response characteristics. Therefore, for the existing conditions, a reduced-mass model can be used to represent the dynamic response of the more complex system.

54967 (INIS-mf—4639, pp vp) **Buried pipes under earthquake excitation.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54968 (INIS-mf—4639, pp vp) **Seismic analysis and design of electrical cable trays and support systems.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54969 (INIS-mf—4639, pp vp) **Proving test of earthquake resistant piping and active components.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54970 (INIS-mf—4639, pp vp) **Economic affect of increased seismic load on nuclear power plant design and construction costs.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54971 (INIS-mf—4639, pp vp) **Analysis of uncertainty in seismic response of secondary appendage system.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

This report involves uncertainty analysis of the maximum response properties of the secondary appendage system such as piping and other mechanical equipment in nuclear power plant and other industrial facilities. Analysis is performed by using a simplified coupled supporting - appendage model. Representative 19 records of strong motion earthquakes are introduced for this analysis. Especially, attention is focussed on the response characteristics of the appendage at the work condition where the natural period of supporting structure coincide with that of appendage. Response properties are represented by the form of proposed floor response amplification factor (FRAF) which is obtained from the Tsub(a) - Tsub(s) envelope response spectrum and ordinary response spectrum for building structure. Uncertainty of these FRAF is investigated by calculating the expected value and coefficient of variance. It is clarified that fluctuation of the FRAF becomes much smaller than that of Tsub(a) - Tsub(s) envelope spectrum.

54972 (INIS-mf—4639, pp vp) **Study of fuel block collision in HTGR core.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The study of contact phenomena, such as stress wave propagation, contact time and rebound velocity, as well as the numerical method suitable for this study is presented. A matrix-vector modification technique, or the Sherman-Morrison method, in conjunction with the finite element method and Newmark's integration scheme is used. In using finite element methods for structural analysis, the hexagonal graphite block containing fuel holes and coolant holes is idealized by thousands of elements and nodes. The corresponding matrix-vector equation, derived from the variational principle, includes likewise many thousands of components. As the surface of the structure comes in contact with an other structure, the boundary condition changes are represented by a localized modification to the matrix-vector equation. In considering local plastic deformation, computations are minimized by expressing the relevant modification to the element stiffness matrix in terms of the product of a vector and its transpose. The modification is incorporated into the solution in a manner such that the frequent contact-release phenomenon can be treated with ease. Convergence of the procedure is demonstrated by solving Hertzian problems. Agreement with Hertz' theorem is obtained with a relatively crude mesh representation and time step size. Numerical results of corner and flat face impact of similar and dissimilar blocks are presented. A longer contact time and higher peak stress are found as expected for the corner impact. The rebound velocity appears to be lower for blocks with holes than for blocks without holes. Results for a 7-hole block are compared with experiments. The significance of this comparison is discussed.

54973 (INIS-mf—4639, pp vp) **Response of a reactor coolant pump to time history seismic displacements.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54974 (INIS-mf—4639, pp vp) **Seismic response analysis of structural system to multiple support excitations.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

54975 (INIS-mf—4945) **Radiation protection in Baden-Wuerttemberg. 2nd medium-term program of the regional government.** (Ministerium fuer Ernaehrung, Landwirtschaft und Umwelt Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1978. 106p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

The tasks of radiation protection and nuclear safety to be looked after by the land Baden-Wuerttemberg consist essentially in licensing and control activities carried out by the Federal Government. With regard to radiation protection the focal points of the second medium-term programme of the Laender Government Baden-Wuerttemberg are: 1. the technical development plan 'power plant sites', 2. construction of nuclear power plants in the borderline areas of neighbouring foreign countries, 3. disposal of radioactive waste, 4. pollution protection measures against nuclear power plants, 5. safety measures when dealing with radioactive materials outside nuclear power plants.

54976 (INKA-Conf—78-078-002) **Response of unirradiated and irradiated PWR fuel rods tested under power-cooling-mismatch conditions.** MacDonald, P.E.; Quapp, W.J.; Martinson, Z.R.; McCardell, R.K. (EG and G Idaho, Inc., Idaho Falls (USA)); Mehner, A.S. (Idaho State Univ., Pocatello (USA)). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 25p. (CONF-781147—10). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 6. meeting of the projekt nukleare sicherheit; Karlsruhe, F.R. Germany (28 Nov 1978).

This report summarizes the results from the single-rod power-cooling-mismatch (PCM) and irradiation effects (IE) tests conducted to date in the Power Burst Facility (PBF) at the U.S. DOE Idaho National Engineering Laboratory. This work was performed for the U.S. NRC under contact to the Department of Energy. These tests are part of the NRC Fuel Behavior Program, which is designed to provide data for the development and verification of analytical fuel behavior models that are used to predict fuel response to abnormal or postulated accident conditions in commercial LWRs. The mechanical, chemical and thermal response of both previously unirradiated and previously irradiated LWR-type fuel rods tested under power-cooling-mismatch condition is discussed. A brief description of the test designs is presented. The results of the PCM thermal-hydraulic studies are summarized. Primary emphasis is placed on the behavior of the fuel and cladding during and after stable film boiling.

54977 (INKA-Conf—78-078-003) **Thermal-hydraulically controlled blowdown tests in the experimental facility COSIMA to study PWR fuel behavior: experimental and theoretical results.** Class, G.; Hain, K.; Meyder, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 22p. (In German). (CONF-781147—9). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 6. meeting of the projekt nukleare sicherheit; Karlsruhe, F.R. Germany (28 Nov 1978).

The fuel behavior in the blow-down phase of a LOCA is of importance for fuel rods with high internal pressure and high rod power, because of the effects on clad failure of the small cladding deformations occurring. The operating results of the COSIMA facility show that, on the basis of the new developments for measuring technique and fuel rod simulators performed, reactor relevant blow-down performances can be conducted in a controlled and reproduceable manner. The mechanical and thermal-hydraulic states occurring in the test bed may be subject to computational checking. This permits on one hand to improve the computing models and on the other yields a confirmation of the high state of development of the available computer codes. Therefore it appears that, with the results from COSIMA and the associated theoretical work in the field of the blow-down process, difficult to treat experimentally, an essential contribution to verifying the models for accident calculations is given. The work scheduled for the next about 1 1/2 years will serve to further support the rather preliminary results and to extend the range of then application.

54978 (INKA-Conf—78-078-005) **Methods of analysis for core meltdown accidients in light water reactors.** Denning, R.S.; Baybutt, P.; Cybulskis, P.; Gieseke, J.A.; Jordan, H.; Wooton, R.O. (Battelle Columbus Labs., OH (USA)). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 26p. (CONF-781147—8). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 6. meeting of the projekt nukleare sicherheit; Karlsruhe, F.R. Germany (28 Nov 1978).

This paper describes the status of two research programs at the Battelle, Columbus Laboratories, in which improved methods of analyzing the behavior of hypothetical fuel melting accidents in LWR being developed. In one program the MARCH/CORRAL code package has been written to perform an integrated analysis of thermal-hydraulic response and radionuclide transport within containment in meltdown accidents. In the other program, the TRAP code is under development for the analysis of radionuclide transport and deposition in the reactor primary system.

54979 (INKA-Conf—78-078-006) **Fission product source terms for LOCAs and hypothetical core melt-down accidents.** Albrecht, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie); Malinauskas, A.P. (Oak Ridge National Lab., TN (USA). Chemical Technology Div.). (Zentralstelle fuer Atom-

kernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 31p. (In German). (CONF-781147—6). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 6. meeting of the projekt nukleare sicherheit; Karlsruhe, F.R. Germany (28 Nov 1978).

This paper describes two experimental projects for the study of fission product release at different boundary conditions. By the work done at Oak Ridge until now the temperature range of the loss-of-coolent accident (500-1200°C) is covered; in additional experiments this range is extended to 1600°C. The results obtanied are of special importance for the fission products Cs and I, for they mean to say that the release at 1200°C is lower by the factors of 200 respectively 60 than assumed in the Rasmussen Report. For the calculation of the source term for these elements a semiempirical model was developed, well describing the experimental results from several series of experiments despite much different boundary conditions. In the PNS experimental program the release for hypothetical core melt-down accidents in the temperature range between 1200 and 2700°C is studied. With the melt-down facility SASCHA, described in this paper, for the first time experiments can be performed at realistic boundary conditions with melted masses of up to at least 1 kg. Set up and development of the experimental technique taking several years, for the present there are not enough experimental data available for the calculation of the integral source term under core melt-down conditions. Nevertheless the release in air for about a dozen elements and melted masses of 30-300 g could be determined.

54980 (INKA-Conf—78-078-007) **Reduction of released fission products in PWR containments (NAUA code).** Bunz, H.; Schoeck, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 19p. (In German). (CONF-781147—7). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 6. meeting of the projekt nukleare sicherheit; Karlsruhe, F.R. Germany (28 Nov 1978).

At the moment the NAUA code is the only activity for investigating the behavior of particulate fission products in a condensing atmosphere. By parameter variations there may be drawn from calculations with the NAUA code qualitative conclusions on the reduction of aerosols in the post-accident atmosphere of a LWR containment. Of special importance is the result that a high initial release is not conservative. This is true with and without taking account of the condensation of steam on the aerosol. The influence of condensation in any case causes a marked acceleration of the reduction process. For quantification of the condensing phenomena an experimental program was started. Results from measurements of the condensation on metal oxide aerosols were used for correcting the model equations. Further experiments deal with soluble aerosols and with the influence of the containment walls.

54981 (INTAT—78-70, pp 49-63) **Shutdown concepts of high-temperature reactors.** Brandes, S. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (Germany, F.R.)); Lohnert, G. (Gesellschaft fuer Hochtemperaturreaktor-Technik m.b.H., Bergisch Gladbach (Germany, F.R.)); Wolf, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Aug 1978. (In German).

From KTG special meeting of the Fachgruppe Brennelemente; Bergisch Gladbach, F.R. Germany (25 Nov 1977).

The present meetings report gives a survey an the state of development of absorbers of high-temperature reactors. Numerous materials, material combinations and geometrical configurations are for neutron-physical reasons possible for various reactor concepts of control and shutdown. Boron carbide is primarily the reference material in HTR, however numerous alternatives to realize long-term project targets are being still persued.

54982 (KFK—2691) **Fuel element behavior during a loss-of-coolant accident and interaction with the emergency core cooling.** Erbacher, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit; Kerntechnische Gesellschaft im Deutschen Atomforum e.V., Bonn (Germany, F.R.)). Sep 1978. 24p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

The process of emergency core cooling in a LOCA of a pressurized water reactor is summarized. The thermohydraulics in the reactor core and the loading of the fuel rod claddings during a LOCA are covered in more detail. Some recent experimental results on Zircaloy cladding deformation in a LOCA are discussed. They indicate that axial and azimuthal cladding temperature differences, which are enhanced by cooling during reflooding, are limiting the strains of the Zircaloy cladding tubes and the resulting coolant channel blockage in the fuel elements.

54983 (LA-UR—79-2141) **Influence of TREAT nonprototypic effects on prediction of pin failure in LMFBRs.** Mast, P.K.; Scott, J.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790816—41). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The effect of the nonprototypic stagnant coolant environment in the static-capsule TOP TREAT tests has been investigated using the LAFM code. The cladding temperature was shown to be higher relative to the fuel temperature for the simulated 50 cents/s transients than in a hypothetical 50 cents/s FTR transient. This higher relative cladding temperature significantly decreases the importance of fuel-cladding differential thermal expansion as a failure mechanism and causes concern about the direct applicability of the 50 cents/s static-capsule TREAT test results to hypothetical FTR transients.

54984 (LA-UR—79-2245) **Integral postdisassembly energetics test: a preliminary investigation.** Barts, E.W.; Asprey, M.W.; Burns, R.D. III; Chapyak, E.J.; Dunwoody, W.E.; Helmick, H.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790816—44). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Scaled, real-material integral tests could demonstrate mitigating mechanisms in postdisassembly energetic behavior during a hypothetical accident in a liquid metal fast breeder reactor (LMFBR). Such a test series could provide key data for accident analysis codes and LMFBR design and licensing. Studies were performed to determine important system parameters including the test geometry necessary to maintain prototypicality. Neutronic behavior of the core and radial blanket configuration was studied to assure a controlled energetic burst. An engineering design study was performed to determine test feasibility.

54985 (LA-UR—79-2285) **Examination of subassembly scale fuel motion using the SIMMER-II code.** Alcouffe, R.E.; Henninger, R.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790865—1). Dep. NTIS, PC A02/MF A01.

From ANS/ENS international meeting on fast reactor safety technology; Vancouver, Canada (19 Aug 1979).

Subassembly scale motion during the early fuel dispersal and extended fuel motion phases of an LMFBR loss of flow accident are examined with the SIMMER-II code. Results are compared and contrasted with previous analyses and selected experiments. The early fuel motion with a SIMMER-II model is calculated with the results given by the SLUMPY module of the SAS3A code. SLUMPY may greatly overpredict the extent and magnitude of fuel motion on the time scale of interest using the nominal SLUMPY parameters. By comparing with pin geometry fuel freezing experiments, SIMMER-II is calibrated to calculate the experimental fuel penetration distances.

54986 (LA-UR—79-2340) **Some recriticality studies with SIMMER-II.** Bohl, W.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790816—38). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The SIMMER-II code was applied to the problem of evaluating the potential for recriticality in an LMFBR HCDA. The phenomenology examined was based on the post SAS3D behavior in a CRBR LOF accident. The SIMMER-II results were found to be sensitive to the development of fuel blockages. If blockages were formed close to the core, the core-disruption phase of the behavior resulted from the significant energy required following SAS3D termination to raise the average steel temperature to saturation conditions; also material deposition near heat sinks eliminated condensation surfaces and induced core pressurization and fuel collapse. Excessive ramp rates (greater than $100/s) were judged to be unlikely, but improved knowledge and calculational treatments of the applicable phenomenology would be desirable.

54987 (LTR—20-102) **LOFT small break RELAP4 model.** Burtt, J.D. (Idaho National Engineering Lab., Idaho Falls (USA)). Jul 1979. Contract EY-76-C-07-1570. 80p. Dep. NTIS, PC A05/MF A01.

The purpose of this report is to present the RELAP4/MOD6 model developed to study small break transient tests in LOFT. This 19 volume model was based directly on the more detailed 53 node and 29 node models currently in use. Comparisons between LOFT model predictions and data taken from Semiscale Test S-02-6 were completed to show that the model adequately handles small break hydraulic phenomena. A communicative break model based on this small break model was developed and a comparison was made between the two. While the communicative break calculations showed a slower transient, the phenomena seen were basically identical. Therefore, a plant modification to LOFT was not recommended.

54988 (LTR—20-104) **RELAP4/MOD6 prediction comparisons with LOFT LOCE L2-3 data.** Keeler, C.D.; White, J.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 84p. Dep. NTIS, PC A05/MF A01.

A comparison is presented between RELAP4/MOD6 predicted and experimental measured quantities for Loss-of-Coolant Experiment (LOCE) L2-3 performed in the Loss-of-Fluid Test (LOFT) facility. These data comparisons provide a detailed record for subsequent analysis. Comparisons indicate that the trends in the system hydraulic response were generally well predicted. The core thermal response, in general, was not well predicted due to the code failing to predict the early rewet. It is recommended that future LOCE L2-3 posttest analysis efforts be centered on gaining a better understanding of modeling rewet phenomena with the RELAP4/MOD6 heat transfer surface. Better modeling of the performance of the steam generator secondary side is also needed before modeling small break LOCEs.

54989 (LTR—1111-58) **Uncertainty in predicted loft reflooding response: influence on cladding oxidation.** Niebruegge, D.A.; Tolman, E.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 15 Aug 1979. Contract EY-76-C-07-1570. 52p. Dep. NTIS, PC A03/MF A01.

Semiscale gravity feed reflood and FLECHT-SET tests have been reviewed to determine phenomena which may be important during LOFT reflood. FLOOD4 and RELAP4/MOD6 predictions for Semiscale and FLECHT-SET tests were compared to experimental data. Based on these comparisons, uncertainties were estimated for the LOFT reflood predictions; these uncertainties were then utilized to bound the extent of cladding oxidation expected for the LOFT L2-3 and L2-4 tests.

54990 (LTR—1111-61) **Effects of non-uniform core flow on peak cladding temperature: MOXY/SCORE sensitivity calculations.** Chang, S.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 15 Aug 1979. Contract EY-76-C-07-1570. 47p. Dep. NTIS, PC A03/MF A01.

The MOXY/SCORE computer program is used to evaluate the potential effect on peak cladding temperature of selective cooling that may result from a nonuniform mass flux at the core boundaries during the blowdown phase of the LOFT L2-4 test. The results of this study indicate that the effect of the flow nonuniformity at the core boundaries will be neutralized by a strong radial flow redistribution in the neighborhood of core boundaries. The implication is that the flow nonuniformity at the core boundaries has no significant effect on the thermal-hydraulic behavior and cladding temperature at the hot plane.

54991 (NUREG—0533) **Aircraft impact risk assessment data base for assessment of fixed wing air carrier impact risk in the vicinity of airports.** Akstulewicz, F.; Read, J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Site Safety and Environmental Analysis). Jun 1979. 97p. NTIS.

The FIXED WING AIRCRAFT accidents occurring to US air carriers during the years 1956 through 1977 are listed, with those resulting in impact within five miles of airports in the contiguous US being considered in detail as to location of impact relative to the airport runways.

54992 (NUREG—0578) **TMI-2 Lessons Learned Task Force status report and short-term recommendations.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1979. 70p. NTIS.

Review of the Three Mile Island accident by the TMI-2 Lessons Learned Task Force has disclosed a number of actions in the areas of design and analysis and plant operations that the Task Force recommends be required in the short term to provide substantial additional protection which is required for the public health and safety. All nuclear power plants in operation or in various stages of construction or licensing action are affected to varying degrees by the specific recommendations. The Task Force is continuing work in areas of general safety criteria, systems design requirements, nuclear power plant operations, and nuclear power plant licensing.

54993 (NUREG/CR—0312) **Effect of scale on two-phase countercurrent flow flooding. Final report, July 1977-June 1978.** Richter, H.J.; Wallis, G.B.; Speers, M.S. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Jun 1979. 39p. NTIS.

Air-water countercurrent flow experiments have been performed in vertical tubes of different sizes and in annuli with different gap sizes. The gas velocity sufficient to produce zero penetration of liquid in large tubes (6" and more) seems to be the same. For 2" diameter tubes the flooding behavior can be represented by the Wallis correlation. In large tubes and annuli it was assumed that all liquid penetrated in the form of a film along the walls. A force balance on this liquid film leads to a correlation, which predicts the flooding behavior in most cases satisfactorily.

54994 (NUREG/CR—0813) **Qualification Testing Evaluation program light water reactor safety research. Quarterly report, October-December 1978.** Bonzon, L.L.; Gillen, K.T.; Salazar, E.A. (Sandia Labs., Albuquerque, NM (USA)). Jun 1979. Contract EY-76-C-04-0789. 120p. (SAND—79-0761). Dep. NTIS, PC A06/MF A01.

The objectives of the QTE program are to obtain data needed for confirmation of the suitability of current standards and regulatory guides for Class IE safety-related equipment and to obtain data that will provide an improved technical basis for modifications of these standards and guides where appropriate. Specific major objectives of the research are: (1) To provide assessments of post-LOCA qualification testing methodologies, including a qualitative assessment of the synergistic effects resulting from the combined environmental testing of representative Class 1E equipment; (2) To determine the radiation environment from the nuclear source term for a design basis LOCA and evaluate the adequacy of radiation simulators; and (3) To provide methods that can be used to simulate the natural aging process of representative Class 1E materials by accelerated aging methods.

54995 (NUREG/CR—0861) **Summary and bibliography of safety-related events at pressurized-water nuclear power plants as reported in 1978.** Scott, R.L.; Gallaher, R.B. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 33p. (ORNL/NUREG/NSIC—165). Dep. NTIS, PC E02/MF E02.

This bibliography contains 100-word abstracts of reports submitted to the US Nuclear Regulatory Commission concerning operational events that occurred at pressurized-water-reactor nuclear power plants in 1978. The 2084 abstracts included in the bibliography describe incidents, failures, and design or construction deficiencies experienced at the facilities. They are arranged alphabetically by reactor name and then chronologically for each reactor. Keyword and permuted-title indexes are provided to facilitate location of the abstracts of interest. Tables summarizing the information contained in the bibliography are also presented. The information listed in the tables includes instrument failures, equipment failures, system failures, causes of failures, deficiencies noted, and the time of occurrence (i.e., during refueling, operation, testing, or construction). Three of the more interesting events that occurred during the year are reviewed in detail.

54996 (NUREG/CR—0900) **Evaluation of materials for retention of sodium and core debris in reactor systems. Annual progress report, September 1977-December 1978.** Swanson, D.G.; Zehms, E.H.; McClelland, J.D.; Meyer, R.A.; van Paassen, H.L.L. (Aerospace Corp., El Segundo, CA (USA). Materials Sciences Lab.). Dec 1978. 49p. NTIS.

This report considers some of the consequences of a hypothetical core disruptive accident in a nuclear reactor. The interactions expected between molten core debris, liquid sodium, and materials that might be employed in an ex-vessel sacrificial-bed or in the reactor building are discussed. Experimental work performed for NRC by Sandia Laboratories and Hanford Engineering Development Laboratory on the interactions between liquid sodium and basalt concrete is reviewed. Studies of molten steel interactions with concrete at Sandia Laboratories and molten UO_2 interactions with concrete at The Aerospace Corporation are also discussed. The potential of MgO for use in core containment is discussed and refractory materials other than MgO are reviewed. Finally, results from earlier experiments with molten core debris and various materials performed at The Aerospace Corporation are presented.

54997 (NUREG/CR—0902) **Power-cooling-mismatch test series test PCM-3 test results report.** Owen, D.E.; Vinjamuri, K. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 75p. (TREE—1335). Dep. NTIS, PC E03/MF E03.

The results from Power-Cooling-Mismatch Test PCM-3 are presented. The primary objective of the test was to determine the behavior of previously unirradiated pressurized water reactor (PWR) fuel rods operated under sustained film boiling conditions with cladding temperatures in the alpha plus beta temperature range (1105 to 1245 K). Information was also obtained on the thermal-hydraulic conditions affecting the onset, propagation, and termination of departure from nucleate boiling (DNB). Four PWR-type fuel rods were subjected to five DNB cycles in a PWR environment in the in-pile test loop of the Power Burst Facility. Departure from nucleate boiling was induced by reducing coolant flow while maintaining a constant rod peak power of about 54 kW/m. The first four DNB cycles were short, whereas film boiling operation lasted for up to 45 seconds during the fifth cycle. Cladding temperatures for two rods stabilized in the alpha-phase temperature range (810 to 1105 K), and the cladding temperatures of the other two rods reached the beta-phase temperature range (> 1245K).

54998 (NUREG/CR—0949) **Analytical/experimental correlation of a nonlinear system subjected to a dynamic load.** Anderson,

J.C.; Masri, S.F. (University of Southern California, Los Angeles (USA). Dept. of Civil Engineering). Jul 1979. 48p. NTIS.

Analytical and experimental studies of the dynamic response of a system with geometric and material nonlinearity are described. The dynamic excitation consists of sinusoidal and impulsive base acceleration. The dynamic system, which is reprsentative of many practical cases involving mechanical equipment and piping systems, consists of a cantilever beam with a gapped support at the free end. The material nonlinearity considers both the effect of yielding and the effect of strain rate on the initial yield level. The analytical studies are performed by transforming the continuous system to an equivalent single-degree-of-freedom system and using numerical techniques to solve the resulting equation of motion. Experimental studies are conducted and responses are measured on the same dynamic systems. Critical comparisons are made between the calculatd and measured responses.

54999 (NUREG/CR—0967) **Quarterly progress report on fission product behavior in LWRs for the period January-March 1979.** Malinauskas, A.P . (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 29p. (ORNL/NUREG/TM—332). Dep. NTIS, PC A03/MF A01.

The four scheduled tests in the High Temperature Test Series have been completed. High-burnup fuel rod segments from the H.B. Robinson-2 reactor were used in this series. The releases obtained for ^{85}Kr, ^{134}Cs, and ^{129}I from the 30.5-cm-long induction-heated segments are summarized. A large increase in release between 1300 and 1400°C suggests that a mechanism other than normal diffusion from either the gap or the UO_2 matrix has become dominant. This release mechanism is probably the linkage of bubbles at grain boundaries to form tunnels connecting to open void spaces. Since only about half of the length of each specimen was at test temperature, the release values presented should be approximately doubled in order to obtain a more realistic estimate of the percentage release from the 16.0-cm heated section.

55000 (NUREG/CR—0971) **Stability enhancing two-step method for one-dimensional two-phase flow.** Mahaffy, J.H. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 17p. (LA—7951-MS). Dep. NTIS, PC A02/MF A01.

A two-step method which eliminates the Courant-type stability limits found in many methods has been developed for one-dimensional numerical simulation of fluid flow. The cost of this method is less than the more traditional fully implicit approach.

55001 (ORNL/TM—6778) **Comparison of numerical results with experimental data for single-phase natural convection in an experimental sodium loop (THORS bundle 6A).** Ribando, R.J.; Clapp, N.E.; Fontana, M.H.; Hanus, N.; Nelson, W.R.; Wantland, J.L. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-74-05-ENG-26. 88p. AT.

A comparison is made between computed results and experimental data for single-phase natural convection in an experimental sodium loop. The tests were conducted in the Thermal-Hydraulic Out-of-Reactor Safety (THORS) facility. Heat generation in the 19 pin assembly during these tests was typical of decay heat levels. Tests were conducted both with zero initial forced flow and with a small initial forced flow. The bypass line was closed in most tests, but open in one. The computer code used to analyze these tests [LONAC (LOw flow and NAtural Convection)] is an ORNL-developed, one-dimensional, single-phase, finite-difference model for simulating forced and free convection transients in the THORS loop.

55002 (SAN—0115-T6) **Experimental studies in CDA work-energy attenuation. Quarterly progress report No. 18, 1 April-30 June 1979.** Tobin, R.J.; Cagliostro, D.J.; Romander, C.M. (SRI International, Menlo Park, CA (USA)). 30 Jun 1979. Contract EY-76-C-03-0115-097. 17p. Dep. NTIS, PC A02/MF A01.

A study on the CDA energetics necessary to generate missiles that could reach the secondary containment of a large-LMFBR is described. Scaling and prototypicality analyses on CDA work-energy attenuation are also described.

55003 (SAND—79-0057C) **Study of the dispersive potential of irradiated fuel using in-core experiments.** Worledge, D.H.; Cano, G.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790816—42). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Under prompt burst conditions the work potential of expanding fuel vapor is a sensitive function of the ability of fission product gases to cause fuel dispersal milliseconds before dispersal would occur from fuel vapor pressure alone. This relation is of potentially significant importance and merits investigation. A fuel disruption experiment at Sandia Laboratories exhibited rapid disruption probably below but near the fuel melt temperature. The fuel was being heated at 130K/msec when vigorous dispersal occurred in the hottest regions near the fuel melting point. Fuel vapor could not have been responsible. Dispersal is attributed to rapid release of fission product gases under the prompt burst conditions. Further tests are planned to explore this important phenomenon.

55004 (SAND—79-0079C) **Prompt Burst Energetics in the oxide/sodium system.** Reil, K.O.; Young, M.F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790816—34). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A series of twelve Prompt Burst Energetics (PBE) experiments utilizing fresh uranium dioxide fuel pins in stagnant sodium coolant has been performed in Sandia Laboratories' Annular Core Pulse Reactor (ACPR). Results and analysis described in the paper include: observation of FCIs (pressures up to 32 MPa) in the UO_2/Na system, some apparently triggered by small pressure transients (2 MPa); prediction of failure times via the pin model EXPAND; observed thermal-to-mechanical energy conversion ratios up to approximately 0.4%; and identification of potential reactivity effects caused by the pre- and post-failure motion of fuel.

55005 (SAND—79-0081C) **Summary of the first three in-core PAHR molten fuel pool experiments.** Plein, H.G.; Lipinski, R.J.; Carlson, G.A.; Varela, D.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790816—52(Summ.)). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Results from the first three Sandia in-core molten pool experiments are reviewed. Incipient melt of a fully enriched dry bed of UO_2 was achieved in the first experiment while 30g of UO_2 was melted in the second. The melting region developed a void surrounded by a dense crust as indicated by post-test x-radiographs. In the third experiment, a steel layer was melted by an overlying layer of UO_2. Post-test x-radiographs showed no obvious penetration of the steel into the UO_2 porous matrix. Ultrasonic thermometry was used successfully to measure temperatures up to 3100°K. The thermal histories of the in-core experiments were satisfactorily modeled using conduction theory only. Disassembly of the experiment packages will be performed shortly.

55006 (SAND—79-0082C) **Study of heat transfer from a flowing liquid to a melting wall.** Eisenhawer, S.W.; Lee, D.O.; Corradini, M.L.; Ostensen, R.W.; Gonzalez, F. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 23p. (CONF-790816—36). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

In order to investigate fuel freezing phenomenology in the transition phase of an LMFBR accident, a separate effects experiment was conducted. These tests investigated the melting behavior of an ice pipe due to warm refrigerant (R-11) flow. For turbulent flow, the water film is not entrained and the Nusselt number is not sensitive to the Reynolds number for a fixed mass flow rate. A thin film heat transfer model shows good agreement with the experimental results. When this thin film model is applied to the transient freezing and melting process in a fuel-steel LMFBR system, the predicted fuel penetration distance is in very good agreement with the experimental results of Spencer and Henry. This is an improvement over past fuel freezing models.

55007 (SAND—79-0091C) **Debris bed heat removal models: boiling and dryout with top and bottom cooling.** Lipinski, R.J.; Rivard, J.B. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-790816—40). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A one-dimensional deep bed model for incipient dryout is developed which predicts deep bed behavior but not shallow bed behavior. A fluidization criterion results which indicates that a debris bed cannot be fluidized by the vapor flow. However, the maintenance of channels within the bed is predicted. A top-subcooled bed model is presented and evidence (both experimental and calculational) is given that the top-subcooled zone removes heat in series (not in parallel) with the boiling zone for sodium-cooled systems. The Sandia D-2 and D-3 top-subcooled dryout data is expressed in terms of non-subcooled dryout and compared with experimental data and model predictions from the literature. The data agrees with several predictions depending on whether the dryout in the boiling zone is dependent on the overlying subcooled zone thickness. A bottom-subcooled bed model is also presented. A post-dryout model is developed to explain the stable dry zone observed in the D-3 experiment and agreement with the data is found. Finally, the top-subcooled and post-dryout models developed are used to make predictions for the upcoming D-4 experiment.

55008 (SAND—79-0107C) **Analysis of Sandia in-pile EOS experiments.** Breitung, W.; Gorham-Bergeron, E.; Murata, K.K.

(Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790816—45). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Preliminary analysis has been carried out of the dynamic in-pile equation-of-state measurements for UO_2, conducted at Sandia Laboratories, aimed at reducing the uncertainties in the effective UO_2 enthalpy corresponding to the measured pressures. Of the remaining width of the p-H band of some 350 J/g, about 200 J/g originate in the uncertainties of the analytical modelling and about 150 J/g result from the scatter in the experimental data.

55009 (SAND—79-0112C) **Prompt Burst Energetics (PBE) experiment analyses using the SIMMER-II computer code.** Tomkins, J.L.; Hitchcock, J.T.; Young, M.F. (Los Alamos Scientific Lab., NM (USA); Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-790816—47). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Two of the Prompt Burst Energetics (PBE) in-pile experiments conducted at Sandia Laboratories PBE-5S and PBE-SG2, have been investigated with SIMMER-II. These two tests utilize fresh uranium oxide and fresh uranium carbide pins, respectively, in stagnant sodium. The purpose of the analysis is to investigate the applicability of SIMMER-II to this type of experiment. Qualitative agreement with measured data is seen for PBE-5S. PBE-SG2 results agree somewhat less well but demonstrate SIMMER-II's potential for describing fuel-coolant-interactions with further model development.

55010 (SAND—79-0123C) **Fuel-coolant interaction-phenomena under prompt burst conditions.** Jacobs, H.; Young, M.F.; Reil, K.O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-790816—33). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The Prompt Burst Energetics (PBE) experiments conducted at Sandia Laboratories are a series of in-pile tests with fresh uranium oxide or uranium carbide fuel pins in stagnant sodium. Fuel-coolant-interactions in PBE-9S (oxide/sodium system) and PBE-SG2 (carbide/sodium) have been analyzed with the MURTI parametric FCI code. The purpose is to gain insight into possible FCI scenarios in the experiments and sensitivity of results to input parameters. Results are in approximate agreement for the second (triggered) event in PBE-9S (32 MPa peak) and the initial interaction in PBE-SG2 (190 MPa peak).

55011 (SAND—79-0126C) **Medium-scale melt-sodium fragmentation experiments.** Chu, T.Y.; Beattie, A.G.; Drotning, W.D.; Powers, D.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 15p. (CONF-790816—35). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The results of a series of fragmentation experiments involving up to 20 Kg of thermitically produced high temperature melts and 23 Kg of sodium are presented. Except for one experiment where some centimeter size particles are observed, the fragment distributions seem to be in the range of previous data. Spatial distribution of the fragments in the debris bed appears to be stratified. Scanning electron micrographs of fragments indicate fragmentation to be occurring in the molten state for the more intense interactions observed. Interaction data obtained show quiescent periods of 0.5 to 1.5 second between pressure pulses. The force impulse values per unit mass of melt seems to be in the same range as previous experiments.

55012 (SAND—79-0140C) **SPR-III 7-pin in-core fuel motion detection feasibility experiments.** Wright, S.A.; McDaniel, P.J.; Powell, J.E.; Scott, W.H. Jr. (Sandia Labs., Albuquerque, NM (USA); Science Applications, Inc., La Jolla, CA (USA)). 1979. Contract EY-76-C-04-0789. 13p. (CONF-790816—50). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Experiments were performed in the Sandia Pulsed Reactor to demonstrate the feasibility of in-core fuel motion detection. In these experiments fuel motion was mechanically induced and detected by 22 gamma sensitive detectors. A theoretical model using nonlinear perturbation theory was developed to determine the sensitivity of the detectors to fuel motion. This model, together with the measured detector responses, was unfolded using a least squares solution technique to determine the fuel motion. The unfolded motions were then compared with the actual motion to determine the accuracy of the technique. The fuel-mass resolution was +-5 to 10 g for fuel motions less than 75 g. For fuel motions greater than 150 g the resolutions were +-16 to 22 g. Thus, depending on the fuel-mass resolution required, it appears that the technique of in-core fuel motion detection is feasible for many reactor safety experiments.

55013 (SAND—79-0798C) **Theory and application of the coded aperture fuel motion detection system.** Kelly, J.G.; Stalker, K.T.; McArthur, D.A.; Chu, K.W.; Powell, J.E. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-790816—51). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A fuel motion detection system based on coded aperture imaging has been developed for the Annular Core Research Reactor. Its configuration evolved after investigations were carried out to determine the required system capabilities. The reactor environment, developments in the theory of coded apertures for nuclear radiations and compatibility with prototypical geometries were considered. The system was fabricated and inserted into the ACRR where it has recorded the fuel motion from a single pin subjected to loss of flow accident conditions. In addition, computer simulations have shown that in the reactor environment and for fast data acquisition, coded imaging, particularly with uniformly redundant arrays, offers significant advantages over pinhole camera geometries. The extension of this technique toward imaging of 37-pin bundles and imaging with fast neutrons is also being investigated.

55014 (SAND—79-1602C) **LMFBR accident delineation study: approach and preliminary results.** Williams, D.C.; Sholtis, J.A.; Rios, M.; Worledge, D.H.; Conrad, P.W.; Varela, D.W.; Pickard, P.S. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790816—27). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Event trees have been constructed for all phases of LMFBR accidents. The trees proved useful for identifying meaningful initiating accident categories and containment responses. In these areas, quantification appears feasible, given an adequate data base. Event trees were also used to represent in-core phenomenological questions governing accident progression and energetics, but here quantification appears impracticable because pervasive phenomenological uncertainties exist. Infrequent accident initiation is the dominant factor in assuring low risk. Nevertheless, containment promises an additional measure of risk reduction provided severe energetics are highly unlikely. The delineation served to systematize LMFBR safety issues and should aid in evaluating LMFBR R and D priorities.

55015 (SAND—79-1685C) **Survey of melt interactions with core retention material.** Powers, D.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790816—26). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

A survey of the interactions of up to 220 kg stainless steel melts at 1973°K with the candidate core retention materials borax, firebrick, high alumina cement, and magnesia is described. Data collected for the interactions include rates of material erosion, aerosol generation, gas evolution, and upward heat flux. Borax acts as an ablative solid that rapidly quenches the melt. Firebrick is ablated by the steel melt at a rate of 8.2×10^{-6} m/s. High alumina cement is found to be an attractive melt retention material especially if it can be used in the unhydrated form. Magnesia is also found to be an attractive material though it can be eroded by the molten oxides of steel.

55016 (SAND—79-1708C) **Kinetics of fission-vaporized UO_2 fuel determined from sampled fuel debris.** Elrick, R.M. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-790816—46). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Close-in time-resolved sampling of fuel aerosols, high speed photography, and photometric measurement of fuel temperatures were used to determine the thermal and kinetic characteristics of UO_2 fission heated to vaporization with a single 5 msec FWHM pulse of 2380 KJ/kg. From these data it was possible to obtain energy temperature relations and debris kinetics including particle size, velocity, density, momentum and pressure. These results demonstrate techniques for study of dynamic interactions involving liquid and vapor between fuel, cladding, coolant and structure and produce data important for determining initial HCDA aerosol formation.

55017 (TFBP-TR—309(Rev.1)) **Loss-of-coolant accident test series Test LOC 5. Experiment operating specification.** Yackle, T.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1979. Contract EY-76-C-07-1570. 73p. Dep. NTIS, PC A04/MF A01.

The experiment operating procedure for Test LOC-5 is described. The test will be performed using four, separately shrouded fuel rods of PWR 15 x 15 design. Two rods have been previously irradiated and two rods will be unirradiated. One unirradiated and

one irradiated rod will be backfilled with helium to a pressure typical of beginning-of-life PWR fuel rods, and the other rods will be backfilled to a pressure typical of fuel rods at the end-of-operational life.

55018 (WARD-SR—94000-2) **Nuclear safety and reliability engineering. Quarterly progress report for period ending June 30, 1979.** (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jul 1979. Contract EY-76-C-02-3045-031. 59p. AT.

Progress is summarized in the following LMFBR safety-related areas: (1) safe shutdown reliability, (2) safety analysis in support of low risk design capability, (3) shutdown system reliability testing, (4) inherent shutdown system development, (5) safety analysis in support of limited core damage, (6) safety analysis in support of core debris accommodation, (7) low risk containment design criteria, and (8) control of radiological consequences.

55019 (UCRL-Trans—11500) **Basis program on experimental studies on one-pipe and multiple-pipe arrangements for pressure-suppression systems of nuclear power plants: description of the pressure-suppression test facility of GKSS.** Aust, E.; Fuerst, H.D.; Niemann, H.R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (Germany, F.R.)). Aug 1979. Translation of GKSS—79/E/8. 46p. Dep. NTIS, PC A03/MF A01.

This report presents a detailed description of the large-scale test facility of GKSS for performing one-pipe and multiple-pipe experiments for pressure-suppression systems of nuclear power plants. The design and operating data of the test facility are described and special design features and characteristics of importance as input data for the accompanying development of computer programs and for evaluation of the measured results are mentioned.

55020 (CS-INIS—225, pp 60-74) **Reliability and safety of PWR power plant primary circuit.** Caboun, F. (Skoda, Plzen (Czechoslovakia)). [nd]. (In Czech).

From Symposium on reliability of power-generating facilities; Plzen, Czechoslovakia (15 Nov 1977).

The WWER-440 reactor primary circuit is described with regard to reliability and safety. General problems are discussed of the PWR primary circuit reliability based on operating experience gained so far. It is shown that primary circuit component manufacturers should establish laboratories and testing plants for product testing complying to safety and reliability specifications. It is also shown that the technological, assembly and testing procedures are objective factors whose observance in all stages is affected by the subjective, i.e., the human factor.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 55178

55021 (SAND—79-1642C) **Solar Mechanical Energy Storage Program overview and systems analysis results.** Caskey, B.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-790854—1). Dep. NTIS, PC A02/MF A01.

From Mechanical and mag. energy storage contractor; Washington, DC, USA (19 Aug 1979).

The current status of the Solar Mechanical Energy Storage Program is described, along with the remaining activities before Lawrence Livermore Laboratory assumes program responsibility in October 1979. Contractor results are presented in other papers; preliminary system analyses results for residential flywheel energy storage systems (FESS) are presented. Various phases of the program have addressed small-to-intermediate applications of photovoltaic/wind energy storage utilizing flywheels, compressed air and low head underground pumped hydro technologies.

COMPRESSED GAS

REFER ALSO TO CITATION(S) 55021

55022 (SAN—1331-T2) **Feasibility of compressed air energy storage as a peak shaving technique in California. Volume I. Executive summary.** (Acres American, Inc., Buffalo, NY). [nd]. Contract EY-76-C-03-1331. 21p. Dep. NTIS, PC A02/MF A01.

The purpose of the study was to evaluate the feasibility of CAES use based upon analysis of the status of both underground and aboveground technology, the economic feasibility, and siting feasibility for California.

PUMPED HYDRO

REFER ALSO TO CITATION(S) 54281, 55021

FLYWHEELS

REFER ALSO TO CITATION(S) 55021

55023 (COO—4094-48) **Flywheel energy storage and conversion system for photovoltaic applications.** Millner, A.R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 15p. (CONF-790515—4). Dep. NTIS, PC A02/MF A01.

From International assembly on energy storage; Dubrovnik, Yugoslavia (27 May 1979).

A flywheel energy storage and conversion system has been designed and is now being built at Massachusetts Institute of Technology/Lincoln Laboratory for the United States Department of Energy. It is intended to serve as an interface between a solar photovoltaic array and an ac load, providing output waveform regulation as well as energy storage. Important characteristics include magnetic bearings, an ironless armature motor-generator, and a low-cost flywheel rotor. The system design tradeoffs are described, and a preliminary economic analysis is presented.

55024 (UCRL—83043) **LLL materials program for fiber-composite flywheels.** Rinde, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jul 1979. Contract W-7405-ENG-48. 13p. (CONF-790854—2). Dep. NTIS, PC A02/MF A01.

From Mechanical and mag. energy storage contractor; Washington, DC, USA (19 Aug 1979).

During FY'79 the LLL materials program for fiber-composite flywheels has worked in the areas of matrix resins, stress rupture, static engineering properties, and fatigue, or time-dependent engineering properties. Results are reported for physical and mechanical tests of a low-cost matrix-resin system suitable for service up to 150°C. Results of stress-rupture tests on E-glass at load levels of interest to flywheel designers are reported for the first time. Lifetimes at these levels are longer than those of S-glass in previous tests. Static engineering properties on a Kevlar-49/rubberized-epoxy composite are reported for tests at 25 and 75°C. Properties did not decrease within this temperature range. Creep and fatigue tests were performed over a wide range of stress levels. Both input loads and material-response strains were measured and used to correlate times to failure under creep and fatigue loading histories. Further development may provide a basis for predicting composite-flywheel structural life from laboratory tests.

THERMAL

REFER ALSO TO CITATION(S) 54506, 54507

55025 (STUDSVIK/E—1-78/27) **Development and testing of materials for large hot-water reservoirs.** Berman, J. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Dec 1978. 19p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

The service life of tubes made of different plastic materials being in contact with hot water at temperatures of 80 and 95°C have been investigated. The insulation properties of the materials are discussed.

CHEMICAL

REFER ALSO TO CITATION(S) 54269, 54376, 54377, 54379

55026 (LA—7822) **New heat transfer geometry for hydride heat engines and heat pumps.** Steyert, W.A. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

Hydrides offer many advantages as working materials in heat engines, heat pumps, hydrogen compressors, and other thermomechanical systems. The report discusses a porous metal hydride ($LiNi_5H_6$) composite that will provide mechanical stability to hydride beds and will provide excellent heat transfer to the hydride when used in the appropriate configuration.

BATTERIES

DESIGN AND DEVELOPMENT

55027 (ANL—79-64) **Development of lithium/metal sulfide batteries at Argonne National Laboratory: summary report for 1978.** Nelson, P.A.; Barney, D.L.; Steunenberg, R.K. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 42p. Dep. NTIS, PC A03/MF A01.

This report consists of highlights for 1978 of Argonne National Laboratory's program on the development of lithium/metal sulfide batteries. These batteries are being developed for electric-vehicle propulsion and for stationary energy-storage applications. The present cells, which operate at 400 to 450°C, are of a vertically oriented, prismatic design with one or more inner positive electrodes of FeS or FeS_2, facing electrodes of lithium-aluminum alloy, and molten LiCl-KCl electrolyte. During 1978, cell and battery development work continued at ANL, Eagle-Picher Industries, Inc., Gould, Inc., and the Energy Systems Group of Rockwell International. Fabrication of a 40-kWh battery by Eagle-Picher for testing in an electric van is nearing completion. Cost and design studies for a Mark II electric-vehicle battery, which will have somewhat higher performance and use potentially low-cost materials and fabrication methods, were conducted by all three subcontractors, and contracts are being negotiated for development of Mark II batteries. Conceptual design studies continued at Rockwell International on a 100-MWh stationary energy-storage module. The present plan is to construct a module based on these designs for testing at the BEST (Battery Energy Storage Test) Facility. Work was also in progress at the Carborundum Co., General Motors Research Laboratories, and various other organizations on developing materials and components for cells. 9 figures, 7 tables.

55028 (CONF-790538—16) **Overview of basic and applied research on battery systems at Argonne.** Nevitt, M.V. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

The need for a basic understanding of the ion transport and related effects that are observed under the unique physical and electrochemical conditions occurring in high-temperature, high-performance batteries is pointed out. Such effects include those that are typical of transport in bulk materials such as liquid and solid electrolytes and the less well understood effects observed in migration in and across the interfacial zones existing around electrodes. The basic and applied studies at Argonne National Laboratory, centered in part around the development of a Li(alloy)/iron sulfide battery system for energy storage, are briefly described as an example of the way that such an understanding is being sought by coordinated interdisciplinary research. 3 figures.

55029 (CONF-790803—49) **Battery engineering problems in designing an electrical load leveling plant for lithium/iron-sulfide cells.** Zivi, S.M.; Pollack, I.; Kacinskas, H.; Chilenskas, A.A.; Barney, D.L.; Sudar, S.; Goldstein, I.; Grieve, W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The design of a lithium/iron sulfide battery for utility load leveling is strongly dependent on the energy capacity selected for the cells. Battery hardware costs are minimized by the selection of large cells, with 30-kWh cells being the largest that would be consistent with system constraints in a 100-MWh load leveling plant. However, it is anticipated that such large cells may be precluded by system reliability and maintainability considerations, and cell capacities on the order of 1 kWh may be needed to satisfy those requirements. Large cells can be protected against overcharge by electronically controlled charge equalization systems that have been developed for experimental eV batteries. The economics of electronically controlled equalization becomes unfavorable for small load-leveling cells; and if small cells are selected, it will be necessary to develop inherent protective means within each cell, with respect to overcharge.

MATERIALS, COMPONENTS, AND AUXILIARIES

55030 **Raman scattering from $^6Li^+$ and $^7li^+$ ions in lithium beta-alumina.** Kaneda, T.; Bates, J.B.; Wang, J.C. (Oak Ridge Natl Lab, Tenn). *Solid State Commun.*; **28**: No. 6, 469-474(Nov 1978).

Raman bands due to translational modes of $^6Li^+$ and $^7Li^+$ ions in beta-alumina were found in the frequency range of 340-410 cm^{-1}, which is much higher than expected from the corresponding values reported for other alkali-metal ions (20-100 cm;sup -1;). On a basis of a model calculation, it is believed that large shifts to higher frequencies are due to deviation of the Li^+ ions from the mirror plane into "pocket sites" formed by oxygen ions above or below the Beevers-Ross sites.

APPLICATIONS

REFER ALSO TO CITATION(S) 55027

ENERGY MANAGEMENT AND POLICY

55031 (BNL—26179) **C/SCSC overview: approach, implementation, use.** Turf, L. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 16p. (CONF-791029—1). Dep. NTIS, PC A02/MF A01.

From Project management institute seminar symposium; Atlanta, GA, USA (18 Oct 1979).

An overview of the Cost/Schedule Control System Criteria, known as C/SCS or C/S Squared is pesented. In the mid-1960s, several DOD service agencies embarked on a new performance measurement concept to track cost and schedule performance on major DOD programs. The performance measurement concept of C/SCS has expanded from DOD use to the Department of Energy (PMS), NASA (533 reports), and private industry such as shipbuilding, utilities, and construction. This paper describes the C/SCSC with the events leading to the C/SCS requirement, how to approach the requirement, and discusses implementing and using the system. Many government publications, directives, and instructions on the subject are listed in the publication.

55032 (DOE/EIA—FY78) **User guide.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 33p. NTIS, PC A03/MF A01.

A list of microfiche copies of all the EIA publications issued in Fiscal Year 1978 (October 1, 1977, through September 10, 1978) is presented. A DOE/EIA Report Number Index arranges the publications in numerical order by the DOE/EIA number; a Title Index lists alphabetically all the publications; and a Subject Index provides access to the publications by subject matter covered.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 55046, 55082

55033 (BNL—26390) **MARKAL: a multiperiod, linear-programming model for energy systems analysis (BNL version).** Abilock, H.; Bergstrom, C.; Brady, J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 23p. (CONF-791007—3). Dep. NTIS, PC A02/MF A01.

From Energy systems analysis international conference; Dublin, Ireland (9 Oct 1979).

MARKAL is a demand-driven, multiperiod, LP model of energy supplies and demands. Its intended application is at the level of an entire nation. Basically, MARKAL takes exogenously supplied energy-demand figures and determines the optimal energy-supply and end-use-device network that can meet the demand. For a feasible solution, the demand must be met in each period. The exact nature of an optimal solution depends both on the criterion of optimality and the ensemble of technological and economic data supplied by a user to characterize a country's energy technologies. The MARKAL data requirements are of a technological, economic, or policy nature. Basically, for each energy carrier, a user must supply the following information for each applicable period: resource cost, period of first availability, and security weight. For each process, conversion system, and demand device, the requisite data include the following: lifetime, period of first availability, availability factors, energy conversion efficiencies, and costs for investment and fixed variable operation and maintenance. For energy carriers, minimum and maximum bounds on use are optional. So also are minimum and maximum bounds on capacity or utilization for processes, conversion systems, and demand devices. This project assesses realistically the merits of new energy technologies, characterizing their likely technological and economic characteristics.

55034 (BNL—50969) **Annual highlights of the National Center for Analysis of Energy Systems.** Hoffman, K.C. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1978. Contract EY-76-C-02-0016. 133p. Dep. NTIS, PC A07/MF A01.

The National Center for Analysis of Energy Systems at Brookhaven has been in operation since January 1976. This annual highlights report outlines the scope of activities of the Center involving the integrated analyses of technological, economic, environmental, and social aspects of energy at the regional, national, and international levels. The objectives of the Center and major accom-

plishments of 1978 are described along with a list of active projects and publications. The energy data bases and analytical models used in the cousre of policy analyses are also described. The major ongoing activities of the Center include: analysis of energy-economic relationships; regional energy and environmental policy; comparative health effects of alternative energy systems; technology assessment and energy R and D priorities; development of energy-economic-environmental models and data bases; R and D strategies for the International Energy Agency; and energy technologies for developing countries. The multidisciplinary approach used in the Center and the close interaction with other analytical groups in universities and industry provide a unique perspective on the energy situation. This perspective is given emphasis in the 1978 highlights report.

55035 (DOE/EIA—0103/3) **EIA input-output model simulation procedures. Technical Memorandum TM/IA/78-03.** Earley, R.F.; Mohtadi, M.M. (Department of Energy, Washington, DC (USA). Energy Information Administration). 31 Jul 1978. 28p. NTIS, PC A03/MF A01.

The Macroeconomic Analysis Division of the Office of Integrative Analysis operates an input-output (I/O) model which simulates output and employment (jobs) for 129 sectors of the economy and employment by 470 occupational categories for the years 1980 and 1985. The Bureau of Labor Statistics I/O model is based on benchmark interindustry studies published by the Bureau of Economic Analysis (BEA) for the year 1963. A brief overview of the BEA I/O system outlining concepts characteristic of all I/O systems is presented. This is followed by a discussion of the BLS procedure for developing an I/O model capable of making projections for the years 1980 and 1985. Next, the actual simulation procedures used to generate output, employment, and occupational levels with the BLS I/O model are presented. Last, there is a discussion of some of the limitations of the methodology.

55036 (DOE/EIA—0103/15) **Applied analysis modeling capability survey, models index. Research memorandum No. 78-09.** McVearry, A. (Department of Energy, Washington, DC (USA). Energy Information Administration). 22 Feb 1978. 18p. NTIS, PC A02/MF A01.

A listing and brief descriptions of 60 models and their submodels are presented with the Office of Energy Industry Analysis indicating the models it utilizes that are being used elsewhere in applied analysis.

55037 (DOE/EIA/70313—1) **Generalized equilibrium modeling: the methodology of the SRI-Gulf energy model. Final report.** Gazalet, E.G. (Decision Focus, Inc., Palo Alto, CA (USA); Stanford Research Inst., Menlo Park, CA (USA)). May 1977. 50p. Dep. NTIS, PC A03/MF A01.

The report provides documentation of the generalized equilibrium modeling methodology underlying the SRI-Gulf Energy Model and focuses entirely on the philosophical, mathematical, and computational aspects of the methodology. The model is a highly detailed regional and dynamic model of the supply and demand for energy in the US. The introduction emphasized the need to focus modeling efforts on decisions and the coordinated decomposition of complex decision problems using iterative methods. The conceptual framework is followed by a description of the structure of the current SRI-Gulf model and a detailed development of the process relations that comprise the model. The network iteration algorithm used to compute a solution to the model is described and the overall methodology is compared with other modeling methodologies. 26 references.

55038 (EPRI-EA—1108) **Evaluation of the pseudo-data approach. Final report.** Maddala, G.S.; Roberts, R.B. (Fletcher (A.L.) and Associates, Columbia, SC (USA)). Jul 1979. 78p. Dep. NTIS, PC A05/MF A01.

The pseudo-data approach has been developed for long-run energy modeling. The term pseudo-data is misleading because it implies something counterfeit or spurious. The pseudo-data approach is not properly described by these adjectives. The fact is that the pseudo-data are generated from detailed engineering process models and do reflect real world technology. A more descriptive term for the analytical process would be single-equation summarization of process-analysis models. This report presents a critical appraisal of this method. The results of this evaluation are that such single equation summarization is not feasible nor desirable because it results in a loss of vital information. The procedure used in generating the data points (so as to avoid the problem of multicollinearity) is not a useful one. There are two aspects of the approximation issue: (a) How well do the data points chosen approximate the true production surface; and (b) How well does the approximating function approximate the particular set of points chosen. Too much attention has been given to the second problem and too little to the first.

55039 (LBL—9648) **Energy Analysis Program: chapter from Energy and Environment Division Annual Report, 1978.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 52p. Dep. NTIS, PC A04/MF A01.

The environmental, socioeconomic, and human health impacts of many energy development choices will impact a variety of specific processes and technologies, in individual energy delivery pathways, and of total energy-supply packages. It is the set of interconnected impacts to which the Energy Analysis Program directs its attention, and summaries of various reports are presented here, namely: seven reports from the Regional Studies Program; four from Technology Assessment of Solar Energy; one from Solar Ownership and Marketing; two from Distributed Energy Systems; and seven from Energy Conservation: Policy Issues and End Use Scenarios of Savings Potential, including the Project Overview.

55040 **Net energy analysis: handbook for combining process and input-output analysis.** Bullard, C.W. (Dept. of Energy, Washington, DC); Penner, P.S.; Pilati, D.A. *Resour. Energy;* **1**: No. 3, 267-313(Nov 1978).

Methods are presented for calculating the direct and indirect energy requirements for producing all types of goods and services. Procedures for combining process analysis with input-output analysis are described. This enables the analyst to focus data acquisition effects cost-effectively, and to achieve a minimum degree of specified accuracy in the results. The report presents sample calculations and provides the tables and charts needed to assess total energy requirements of any technology, including those for producing or conserving energy. 21 references.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 54283, 54293, 55034, 55039, 55040, 55056, 55058, 55064, 55079, 55131, 55146, 55147, 55158, 55166

55041 (CONF-7906117—1) **Inferred referendum: a rule for committee decisions.** Wolsky, A.; Sanathanan, L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

From 1. international symposium on policy analysis and information systems; Durham, NC, USA (28 Jun 1979).

A new method of social choice is presented. The result of the method coincides with that of majority voting when it does not produce an intransitivity among the alternatives under consideration. When majority voting would produce an intransitivity, the method orders the alternatives in the same way as the transitive constituency would whom the committee members are most likely to represent. Analysis of the application of the method to three alternatives shows that the resulting order depends only on the committee members' votes between pairs of alternatives; the resulting order is less sensitive to irrelevant alternatives than the orders provided by other schemes; when majority voting provides an intransitivity, the hypothesis that, in fact, the committee's constituency is as assumed is almost as likely as the hypothesis that it precisely mirrors the committee.

55042 (COO—4287-13) **Social science energy review. Volume 1, No. 4, Fall 1978.** Black, J.S. (ed.). (Yale Univ., New Haven, CT (USA). Institution for Social and Policy Studies). 1978. Contract EE-77-S-02-4287. 69p. Dep. NTIS, PC A04/MF A01.

A separate abstract was prepared for each of the three sections of this review.

55043 (COO—4287-13, pp 1-25) **World energy demand and world security.** Russett, B. 1978.

In Social science energy review. Volume 1, No. 4, Fall 1978.

Global oil production is expected to reach a peak before the year 1990. Abundant coal supplies in the United States and the social and environmental problems from mining and burning coal are recognized. Nuclear power turns out to be more expensive than it appeared a decade ago, in part because of the formidable safety and environmental hazards posed. Given that supplies of energy are very unevenly distributed across the globe, if energy prices continue to rise over the next decade the potential for violent international conflict is very real. What is known about world energy supply and demand and some implications for energy research and development in the United States and abroad are considered. The author suggests that, for various reasons, solar energy may be even more attractive in global perspective than it is from a more narrowly United States-centered view. Its successful exploitation on a world scale nevertheless requires careful attention to foreign countries' goals and constraints.

55044 (COO—4743-1) **Calculating energy and labor impacts of capital readjustments due to changes in personal consumption. Final report.** Pleszkun, A.R. (Illinois Univ., Urbana (USA)). May 1979. Contract ET-78-S-02-4743. 68p. Dep. NTIS, PC A04/MF A01.

Previous work on the energy and labor impacts of energy-consumption policies has included the effect of respending of money

saved, but not the capital implications of this respending. Here the capital effects are fully accounted for, and turn out to be negligible for a specified conservation scenario and a specified capital expansion model ($\Delta C = kC$). The robustness of this conclusion is discussed. The implication is that inclusion of only the respending effect is adequate for calculating energy and labor impacts and provides an accuracy to within +- 1% of the total impacts. Operationally, this result obviates the requirement for detailed and expensive calculations.

55045 (DOE/CS/20258—1) **Labor and energy impacts of energy conservation measures. First quarterly progress report.** Herendeen, R.A. (Illinois Univ., Urbana (USA)). 12 Apr 1979. Contract AC02-79CS20258. 2p. Dep. NTIS, PC A02/MF A01.

Work has progressed along two lines: obtaining of detailed occupation, industry, wage, and skill information; and obtaining of detailed materials and labor requirements (so-called direct requirements) for conservation and solar options. The latter is currently focused upon thermally tight single-family residences (vs. as-built). Both of these inputs will be used in conjunction with our input-output employment-energy model.

55046 (DOE/EIA—0036/2App.) **Annual report to Congress. Volume II, appendix. Summary data inputs and forecasts for 1985 and 1990.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1978. 734p. NTIS, PC A99/MF A01.

A summary of the key parameters, assumptions, and data inputs that were used to generate the 1985 and 1990 forecasts in Volume II of the EIA Annual Report to Congress, 1977, is presented. Section 2 provides a brief overview of the series projection approach utilized for the AAR. The combinations of macroeconomic, energy reserves, and world crude oil price assumptions used in the projections are also summarized in Section 2. Section 3 illustrates the linkages of the various models used to operate the forecasts. A list of the key values and assumptions used as inputs to the PIES is presented in Section 4. A summary table of the six forecast estimates generated by PIES appears in Section 5. The complete computer output of PIES for each of the projection series is contained in Appendix A. All of the data inputs for each series are included in Appendix B. Four regional maps illustrating the oil and gas supply, refinery, DOE, and coal supply regions are in Appendix C. Appendix D contains a list of the units of measure and conversion factors included in the report.

55047 (DOE/EIA—0102/8) **Evaluation of energy related tax and tax credit programs. Analysis Memorandum AM/IA/78-12.** Kincel, K.L.; Murphy, F.H.; Walton, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). 17 Jul 1978. 126p. NTIS, PC A07/MF A01.

This report presents the results of an EIA analysis of several energy tax and conservation measures associated with the National Energy Act and currently under consideration by the Congress. The measures addressed include: the proposed tax credits for energy conservation and solar investments (H.R. 5263, Parts I and III); petroleum and natural gas user taxes and industrial investment tax credits both as proposed by the President on April 20, 1977, in the National Energy Plan (NEP), and as passed by the Senate (H.R. 5263, Part VI); and the crude oil equalization taxes both as passed by the House (H.R. 8444) and as proposed in the NEP. In order to analyze the impacts of these measures, a modified version of the Series C Projection in the 1977 Administrator's Annual Report (AAR) is used as a reference case. The analysis assesses the impact of each measure applied as follows: conservation and solar tax credits applied to the residential and commercial sectors; petroleum and natural gas user taxes with the industrial investment tax credits in addition to the conservation and solar tax credits; and finally the above measures plus the crude oil equalization tax.

55048 **Investments in capital and learning in natural resource industries.** Fishelson, G. (Tel-Aviv Univ., Israel). *Resour. Energy;* **1**: No. 3, 251-265(Nov 1978).

The optimal extraction and investment plans of a society that extracts and utilizes a natural exhaustible resource (e.g. coal) are examined. The many (in this study two) stages of this process and the employment of other inputs in addition to coal provide opportunities to save on the scarce resource. In particular, the economies of substitution between technologies and between inputs are sought. The Burt and Cummings (1970) and Rausser (1974) models are extended to include direct investment in learning. From the first-order conditions for an optimal solution, the optimal proportions of investment in capital and in learning are derived. The direct investment in learning supplements the learning-by-doing, which is a joint product of the extracted resource and the final product. The total stock of knowledge is thus larger than that generated only by learning-by-doing, a priori implying larger marginal productivities of capital and the exhaustible resource.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 54628, 55096, 55118, 55119, 55120, 55121, 55122, 55123, 55124, 55125, 55551, 55552, 55629, 55632

55049 (COO—4287-13, pp 53-63) **Energy, CO_2, and climate: planning a program of research and analysis.** Hendricks, J.W. 1978. In Social science energy review. Volume 1, No. 4, Fall 1978.

Energy supply plans that call for burning large amounts of coal, oil, and gas will create large amounts of carbon dioxide and is a matter of concern for energy planning. Burning fossil fuels may substantially raise the CO_2 levels in the earth's atmosphere. This could reduce the earth's radiation of energy, resulting in a global warming trend and other climatic changes which would affect agriculture and other important human activities. A simplified summary of the linkage between energy policies and possible CO_2 problems is given and reveals the importance of uncertainties about such things as: the responses of complex natural systems to additional CO_2 emissions, and the feasibility of systems to decide upon and implement CO_2 control strategies. The DOE has formed an Office of Carbon Dioxide Effects Research and Assessment to direct a CO_2 research program. Along with a brief description of this program, the Mapping Group on Energy and the Social Sciences reviews the appropriate role for the social sciences in a research program on the energy-CO_2-climate linkages.

55050 (COO—4750-T1) **Development of a management system for implementing the NEPA process in the Department of Energy. Executive summary. Year one technical progress report.** (Dalton-Dalton-Little-Newport, Cleveland, OH (USA)). Apr 1979. Contract ET-78-C-02-4750. 15p. Dep. NTIS, PC A02/MF A01.

In carrying out its mission, the Department of Energy is responsible for complying with both the broad policy goals and the procedural requirements of the National Environmental Policy Act (NEPA). The departmental unit charged with overseeing DOE conformance with NEPA and related environmental protection statutes is the Office of Environment (EV), whose Assistant Secretary (ASEV) establishes policies and procedures to assure that environmental considerations demonstrably influence agency decision processes at the policy, program, and project levels. In support of ASEV's mission, a comprehensive NEPA Management System (NMS), which would integrate NEPA policy requirements and the production of NEPA documents with basic DOE functions and activities is being developed and tested. To the extent that this objective was achievable in the context of the Department's formative state, the NMS design was to simplify and regularize NEPA activities agency-wide and thereby permit ASEV and the NEPA Affairs Division (NAD/EV) to concentrate on the supervision of system function and specialized problem-solving. As a related management objective, the NMS was to clarify the NEPA-related roles of units within EV and the nature of their interactions with other elements of the Department. As a three-year effort, the development of the NEPA Management System is evolutionary. This report documents the progress made during the first project year and presents findings on the NEPA Management System design in terms of a six-part framework for its future development. In addition, the report treats key logistical considerations related to system implementation and provides an overview of work to be accomplished in the second project year.

55051 (NP—23930) **Solid waste management: hazardous waste. Abstracts from the literature, 1974-1978.** Ware, R.E.; Mitchell, D.P. (comps.). (Environmental Protection Agency, Washington, DC (USA)). 1979. 339p. Environmental Protection Agency, Cincinnati, OH.

This document presents literature contained on the Solid Waste Information Retrieval System (SWIRS) data base maintained until 1979 by the US EPA. References are to literature published between 1974 and 1978. The abstracts are grouped into sections in the bibliography as follows: general; economics; laws and regulations; health and safety; transportation; processing, disposal, and siting, analysis, research, and development; metals and toxic substances; pesticides; and radioactive wastes. (ERB)

55052 (ORAU—142, pp 23-50) **Migratory behavior and flight patterns.** Gauthreaux, S.A. Jr. (Clemson Univ., SC). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

An overview is given of known facts about bird migratory behavior as background to understanding the potential impact of transmission lines on this behavior. The geographical distribution of migrants is concentrated east of the Rockies, partly because the bird population is concentrated in the East and partly because the migration areas extend farther east than the breeding areas. Studies of the seasonal and daily timing patterns, directions, altitudes, and routes are summarized. Wind and temperature are found to be the major weather factors influencing migration. 104 references.

55053 Atmospheric carbon dioxide: possible consequences of future fossil fuel use. Rotty, R.M. (Inst. for Energy Analysis, Oak Ridge, TN). Contract EY-65-C-06-0033. *Resour. Energy;* 1: No. 3, 231-249(Nov 1978).

Accurate and regular measurements of the concentration of CO_2 in the atmosphere during the past 20 years show an accelerating increase. Although clearing of tropical forests has released large amounts of carbon to the atmosphere, evidence is strong that a major contributor is the combustion of fossil fuels. Future energy demands of the world will require extensive further exploitation of fossil fuels, and projections show that without major development of nonfossil fuel alternatives, the atmospheric concentration will double within the next 75 years. Four issues require serious attention: (1) the developing countries will require vastly increased amounts of energy. Major efforts to develop suitable (inexpensive) non-fossil energy sources to meet at least a portion of this demand are required; (2) the distribution of carbon released from fossil fuels and from other anthropogenic sources among the reservoirs of the carbon cycle must be better defined; (3) uncertainties regarding the effect of the increased concentration of CO_2 in the atmosphere on global climate must be reduced; (4) possible political and social responses to a substantial climate change must be studied in order to more fully understand all of the implication of increased atmopheric CO_2.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 55048, 55132, 55133

55054 (FC—5143-T1) **Dutchess County Pyrolysis Project. Summary report: organizational and financial considerations.** (Dutchess County Pyrolysis Project, Poughkeepsie, NY (USA)). Jul 1979. Contract EM-78-G-01-5143. 27p. Dep. NTIS, PC A03/MF A01.

Implementing a resource recovery project involves the organizational frame within which the project will be carried out and a decision as to the method of financing the project. This report concerns these two matters and is based on the assumption that the project will be developed as a county-owned project, and will not be a private development. Organizational alternatives considered are: a department of County government, a county special district, an independent authority, and a joint venture of other municipalities. It is concluded that a public authority would be the acceptable organizational frame for the County. The factors assessed in the development of this conclusion are legal, financial, practical, and political. This alternative would request the New York Legislature to approve Home Rule legislation establishing a public authority to carry out the resource recovery program. The authority so established would be a public benefit corporation of the State of New York. It would have its own board of directors, including members of the county government, county staff, representatives of local jurisdictions, private individuals, or any combination of the above, as Dutchess County deems appropriate.

55055 (UWRL-P—78-005) **Impact of energy resource development on water resource allocations.** Keith, J.E.; Turna, K.S.; Paduchai, S.; Narayanan, R. (Utah State Univ., Logan (USA). Utah Water Research Lab.). May 1978. 109p. Utah State Univ., Logan.

This research used a linear-programming model of the agricultural and energy sectors of Utah to examine the economically efficient allocation of water between agriculture and energy. Data were collected for agricultural returns, costs, and water requirements; energy returns, costs, and water requirements; and water supply costs. Results indicate that if large-scale energy development occurs in the Colorado River Basin in Utah, most of irrigated agriculture will be eliminated, given Utah's consumptive-use constraint under the Upper Colorado River Compact. On the other hand, for two more probable levels of energy development, including the Energy Research and Development Administration's projections for the year 2000, only minor reductions in irrigated acreages would be expected. Under conditions of severe, prolonged drought, energy demands would consume almost all the water currently used in agriculture, given either of the probable scenarios.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 54158

55056 (COO—4287-13, pp 26-52) **Compleat assessor.** Walker, C.A.; Black, J.S. 1978.

In Social science energy review. Volume 1, No. 4, Fall 1978.

The broad view of technology assessment is discussed in four phases: design and cost estimation; analysis of other technological and economic factors; analysis of interactions with humans and institutions; and a review. These phases follow in succession since information from one phase is needed for the following phases. Activities in the four phases can occur simultaneously and the uses of technology assessment can vary. One significant difficulty at present is the fact that professionals in any one discipline can contribute to only a small part of a technology assessment. In this situation it should be helpful to have available a brief description of the entire process in order to provide participants with a basis for placing their own concerns in the broader context of the entire process of technology assessment. An attempt is made to provide such a description. The framework described is being developed as a basis for comparing various energy technologies.

55057 (NP—23996) **State energy development and demonstration: an evaluation.** Lisse, R. (Wisconsin Dept. of Administration, Madison (USA). Office of State Planning and Energy). Feb 1979. 103p. TIC.

The ways in which state governments have responded to the need for research and development are reviewed, and some models are evaluated for their usefulness to Wisconsin. In some states, energy R and D funds and institutes have been established for the primary purpose of providing the seed money necessary to attract a larger share of Federal dollars. In other states, however, it is the perceived deficiencies in the Federal energy programs, the unfilled gaps on the agendas of specific state research and development needs, that provide the primary impetus for creation of a state energy research and development entity of some sort. Some states are closely identified with specific priority research programs. Wisconsin, a state with severe winters and virtually no indigenous fossil fuel resources, has keyed its energy use strategy to the demand side and is pursuing a vigorous conservation plan. Wisconsin's renewable energy resources are wood, other plant biomass, food processing waste, animal wastes, hydrogen, solar radiation, thermal wastes, water flow, and wind and the present status of development of these resources are briefly described. Wisconsin's energy research and development needs and the adequacy of these programs are examined. For determining what options might be applied to Wisconsin's needs, programs in other states were examined. Detailed information on the energy research and development programs in North Carolina, Kentucky, Colorado, California, Minnesota, Ohio, Illinois, New Mexico, Montana, Iowa, Michigan, New Jersey, South Carolina, New York, Hawaii, and Texas are given in Appendix III.

55058 (PNL—3115) **Summary of the structure and dynamics of international trade opportunities for new technologies.** Watts, R.; Campbell, R.; Smith, S.; Sommers, P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 41p. Dep. NTIS, PC A03/MF A01.

This paper first provides a nomenclature and symbol system for describing the infrastructure that supports the export (or the import) of goods between countries. While the principal interest is in the export of high-technology goods to early foreign markets, the principles involved also apply to domestic commercialization of new technologies. The nomenclature-symbol system presented provides a schematic method of displaying complete relationships between actors and functions - an interaction matrix. A second aspect of the paper involves sketching out the need for further work to identify the motives, problems, and constraints of each key actor in international trade, particularly regarding new high-technology products. It is believed that the investigation should emphasize initial phases of market development when the behavior of actors does not appear to follow previous applications of microeconomic theory. Understanding this difference between theory and behavior could improve Federal efforts to commercialize new technologies. 18 references.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 54184, 54185, 54186, 54206, 54211, 54212, 54216, 54218, 54219, 54220, 54221, 54222, 54223, 54224, 54225, 54226, 54227, 54749, 55806, 55856

55059 Aspects of the nuclear controversy in France. Faure, M. (Electricite de France, 75 - Paris). pp 242-248 of Uranium supply and demand. Spriggs, M.J.; Casteel, K.D. (eds.). London; Mining Journal Books (1978).

From 3. international symposium on uranium supply and demand; London, UK (12 Jul 1978).

A brief account is presented of the anti-nuclear movement in France. General elements are summarized as technical (e.g. safety, radiation hazards), economic (cost effectiveness of nuclear power, cost of radioactive waste storage), political, sociological, philosophical. In France, special criticisms relate to the construction of breeder reactors and reprocessing plants. The methods used by the anti-nuclear campaign are discussed, as is the response by industry.

55060 (INIS-mf—4512) **Nuclear power experience in Japan: exposing the myth.** Barrett, N. (Friends of the Earth (Australia),

Melbourne). Jun 1977. 8p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The author proposes that over the last four years the dreams of Japan's nuclear establishment have been severely shaken. Because of widespread public opposition, the nuclear program has fallen further and further behind schedule. Poor efficiency figures have also contributed to a scaling down of electricity production targets. Uranium stocks are said to be sufficient to last well into the 1990's and as a consequence Japan's optimism in seeking to purchase Australian uranium is completely unfounded and based on the belief that the current nuclear malaise is only temporary.

55061 (INIS-mf—4913) **Nuclear energy. Initiating developments. Towards a better understanding of the energy problem.** (Brown, Boveri and Co. Ltd., Baden (Switzerland)). 1978. 64p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

This brochure is intended as a contribution to a better and more general understanding of one of the most urgent problems of present society. Emphasis is laid on three issues that are always raised in the nuclear debate: 1) Fuel cycle, 2) environmental effects of nuclear power plants, 3) waste disposal problems.

55062 **NSAC: in-depth look at Three Mile Island.** Lihach, N.; Zebroski, E. *EPRI J.*; **4**: No. 6, 12-14(Jul 1979).

The Nuclear Safety Analysis Center (NSAC) is hoping to learn what caused the reactor accident at Three Mile Island, what happened during the accident, and how to take advantage of what is learned to prevent future incidents. When the Electric Power Research Institute (EPRI) was asked to make an independent assessment, the NSAC was organized with a separate identity and funded by special contributions from the electric utilities. The Center has nearly completed the first phase of organization and data gathering on the sequence of events. This will be followed by a safety analysis to determine causes and to look for ways to improve nuclear power plant technology. The Center will also serve as a clearing house for studies on the effects of radiation, improvements in instrumentation, and emergency response systems.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 55063, 55109, 55175, 55176

CONSERVATION

REFER ALSO TO CITATION(S) 55044, 55047, 55081, 55127, 55158, 55159, 55160, 55163, 55164, 55165, 55169, 55170, 55171

55063 (COO—4531-5) **Urban energy management.** Porter, R.W.; Nigro, E.F. (Illinois Inst. of Tech., Chicago (USA); Chicago Dept. of Streets and Sanitation, IL (USA)). 1979. Contract EC-77-S-02-4531. 18p. (CONF-7905105—1). Dep. NTIS, PC A02/MF A01.

From Conference on using land to save energy; Chicago, IL, USA (18 May 1979).

Several opportunities for energy management in the urban setting are described including the commercial, industrial, and electric-utility sectors. The emphasis is on conservation through improved utilization and conversion, and the use of refuse and coal. Energy characteristics of a large commercial building are described. The use of incinerated urban refuse to generate industrial process steam is discussed, as is the option of using Refuse Derived Fuel (RDF) to supplement coal in an urban electrical generating station. The potential for cogeneration, the process of efficient simultaneous production of thermal and electrical power, is considered within the context of the electric utility and the private industry. The direct use of coal is considered for an industrial cogeneration plant using fluidized-bed combustion and gas turbine technology. Some economic, regulatory, and practical aspects are summarized.

55064 (UCRL—15087) **Economic impacts of energy conservation and renewable energy sources.** Carlson, R.C. (SRI International, Menlo Park, CA (USA)). 1979. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

This paper develops an overall theory of the economic impacts of alternative energy developments, reviews existing literature on such impacts, and projects economic impacts of alternative energy development scenarios for California. Economic impacts include changes in aggregate employment, unemployment, real income, and real output. Changes in each of these measures are analyzed in circumstances that include incentives or mandates for increased energy conservation or use of renewable energy resources. Sudden cutoffs of conventional energy resources are excluded in this analysis. It is concluded that conservation/renewable energy systems are likely to bring significant short-term employment increases in California under almost any possible scenario. Real income impacts are much more uncertain. Significantly more research is needed on the impact on productivity and industrial location decisions. These impacts could overwhelm all other employment and income effects in the long run. The most important economic characteristics of energy systems are relative cost and degree of import substitution. Low-cost energy systems that substitute for imports would increase both real income and employment.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 54144, 54146, 55043, 55082, 55092, 55093, 55094, 55098, 55107, 55166

55065 (DOE/EIA—0035/1(78)) **Monthly Energy Review, January 1978.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 96p. NTIS, PC A05/MF A01.

The US produced 4.2% more energy in November 1977 than in November 1976. Data are included for stocks of crude oil, fossil fuel imports, average daily consumption of energy from January-October 1977, and retail prices for fuels being consumed. Global aspects of petroleum production and consumption are detailed.

55066 (DOE/EIA—0035/2(78)) **Monthly Energy Review, February 1978.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 95p. NTIS, PC A05/MF A01.

Energy output during December averaged 150 trillion Btus per day. Total domestic energy production in 1977 amounted to 60.2 quadrillion Btus. Data on crude oil production, energy consumption, oil and gas development, and prices on fuels consumed during the month are presented. Details are given for crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power. Global aspects of petroleum consumption and production are given.

55067 (DOE/EIA—0035/3(78)) **Monthly Energy Review, March 1978.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 97p. NTIS, PC A05/MF A01.

Energy production in the US during January 1978 declined to its lowest level in 12 years on an annualized basis. Output during the month totaled 4.53 quadrillion Btus. Fossil fuel imports totaled 1.5 quadrillion Btus during January. Consumption of energy in the US during 1977 totaled 75.93 quadrillion Btus. Utilities produced 197 billion net kWh of electricity during January 1978. International aspects of petroleum consumption and crude oil production are summarized. Specifically, data on crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power, and strategic petroleum reserves are included.

55068 (DOE/EIA—0035/4(78)) **Monthly Energy Review, April 1978.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 96p. NTIS, PC A05/MF A01.

US energy production during the first two months of 1978 totaled 8.7 quadrillion Btus. Domestic energy production during this period averaged 243 trillion Btus per day. Utility electricity output during February 1978 was 6.5% greater than that for February 1977. Data on fossil fuel imports, world crude production and consumption, oil and gas developments, and strategic petroleum reserves are given. Specifically, data on crude oil and refined petroleum products, natural gas, coal, electric utilities, and nuclear power are tabulated.

55069 (DOE/EIA—0035/5(78)) **Monthly Energy Review, May 1978.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 98p. NTIS, PC A05/MF A01.

A feature article, Short-Term Petroleum Supply and Demand, is presented. It was prepared in conjunction with Volume II of the 1977 EIA Annual Report to Congress that presents analyses and projections of US energy supply, demand, prices, and their impacts. An overview report is presented that shows energy production in the US during March 1978 averaged 156.2 trillion Btus per day. Also, the US consumed an average of 219.6 trillion Btus per day of energy. Data are tabulated on fossil fuel imports, stocks of fuels, global petroleum production and consumption, oil and gas developments, and prices of fuels consumed. Specifically, data are compiled on crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power, and stocks of petroleum strategic reserves.

55070 (DOE/EIA—0035/6(78)) **Monthly Energy Review, June 1978.** Gaylor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 93p. NTIS, PC A05/MF A01.

In April, energy production in the US totaled 5.13 quadrillion Btus. Fossil fuels imports into the US in April amounted to 1.4 quadrillion Btus. Revised domestic energy consumption totals for the first quarter of 1978 were 21.2 quadrillion Btus. Production of electricity by utilities amounted to 161.4 billion kWh. Prices of crude and refined products, international aspects of petroleum consumption and production, and oil and gas developments for the month are given. Specifically, data on crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power, and stocks of the strategic petroleum reserves are tabulated.

55071 (DOE/EIA—0035/7(78)) **Monthly Energy Review, July 1978.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 100p. NTIS, PC A05/MF A01.

Energy production in the US during May totaled 5.5 quadrillion Btus. Imports of fossil fuels were down compared to May 1977. Domestic energy consumption patterns have not altered significantly since the Arab oil embargo. Production of electricity by utilities totaled 175.2 billion kWh in May 1978. Other data provided are on oil and gas developments, international aspects of petroleum production and consumption, and prices of fuels consumed in the US during the month. Specifically, data are given on crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power, and stocks of the strategic petroleum reserves. Included is a survey questionnaire asking subscribers to supply DOE with energy information on needs and interests.

55072 (DOE/EIA—0035/8(78)) **Monthly Energy Review, August 1978.** Newman, S.C. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 98p. NTIS, PC A05/MF A01.

During the month of June, domestic production of energy exceeded the level for June 1977. June 1978 production totaled 5.4 quadrillion Btus. Domestic consumption of energy during May was up 7.9% from the May 1977 level. Beginning with this issue, geothermal production and consumption, consumption of net coke imports, and exports of fossil fuels are included in the calculations. Production of electricity by utilities totaled 187.5 billion kWh in June 1978. Data are provided on oil and gas developments, international aspects of petroleum consumption and production, stocks in the strategic petroleum reserves, and prices of fuels consumed during the month. Specifically, data on crude oil and refined petroleum products, natural gas, coal, electric utilities, and nuclear power are given.

55073 (DOE/EIA—0035/9(78)) **Monthly Energy Review, September 1978.** Newman, S.C. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 96p. NTIS, PC A05/MF A01.

During the month of June, domestic production of energy totaled 5.3 quadrillion Btus. Domestic consumption of energy was up 2.4% from June 1977. Data are included on imports of fossil fuels, world crude oil production and consumption, oil and gas developments, and prices of fuels consumed during the month. Specifically, data are provided on crude oil and refined petroleum products, natural gas, coal, electric utilities, and nuclear power.

55074 (DOE/EIA—0035/10(77)) **Monthly Energy Review, October 1977.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1977. 96p. NTIS, PC A05/MF A01.

Domestic energy production in August 1977 averaged 162 trillion Btus per day. Imports of fossil fuels in August were about the same as in July and electricity generation in August declined 2% from its summer peak in July. The US consumed 4.4% more energy in the first 7 months of 1977 than in the same period of 1976. Data are given on additions made to the strategic petroleum reserve, oil and gas developments, and international aspects of petroleum consumption and production. Prices on fuels consumed during the month are tabulated. Specifically, data are given on crude oil and refined petroleum products, natural gas, coal, electric utilities, and nuclear power.

55075 (DOE/EIA—0035/11(77)) **Monthly Energy Review, November 1977.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1977. 95p. NTIS, PC A05/MF A01.

Energy output averaged 171 trillion Btus per day in September. Data on fossil fuel imports, stocks of crude oil and heating fuels, energy consumed in the US, oil and gas exploration and development, prices of fuels consumed during the month, and international aspects of petroleum consumption and production are provided. Specifically, data are supplied for crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power, and stocks in the strategic petroleum reserves.

55076 (DOE/EIA—0035/12(77)) **Monthly Energy Review, December 1977.** Gaynor, J. (ed.). (Department of Energy, Washington, DC (USA). Energy Information Administration). 1977. 93p. NTIS, PC A05/MF A01.

Domestic energy production in October 1977 totaled 5.23 quadrillion Btus. Data are presented on energy production, imports, domestic consumption, fuel stocks, additions to the strategic petroleum reserve, resource development, and prices of fuels consumed during the month. Specifically, data are presented on crude oil and refined petroleum products, natural gas, coal, electric utilities, and nuclear power.

55077 (DOE/EIA—0036/2Ex) **Annual report to Congress. Volume II. 1977 executive summary.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1977. 24p. NTIS, PC A02/MF A01.

Data are tabulated and discussed concerning energy assumption and supply trends and projections under various consumptions. Also included are summaries and schedules of the amounts of energy resources and fuels that can be brought to market at various prices. The projection and analysis procedure; summary of the projections (to the year 1990); the uses of energy; sources of supply (petroleum, coal, natural gas, and other); and analysis of constraints and impacts (financing energy development, competition and regulation, international aspects, economic impacts, and environmental impacts) are presented.

55078 (DOE/EIA—0102/11) **Motor gasoline supply and demand through 1980. Analysis Memorandum AM/ES/78-19.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 38p. NTIS, PC A03/MF A01.

Estimates of motor gasoline supply and demand provided to the Economic Regulatory Administration are presented and the methodology used to derive those estimates is described. In this analysis a regional econometric model is used to estimate future motor gasoline demand based on alternate assumptions about economic growth. Next, a refinery model is used to estimate the refining capacity required to meet the projected demand levels. Projected refining capacity requirements are compared with projected available refinery capacity to determine whether motor gasoline supply will be adequate to satisfy the projected demand.

55079 (DOE/EIA—0102/17) **Sector employment implications of alternative energy scenarios.** Earley, R.F.; Mohtadi, M.M. (Department of Energy, Washington, DC (USA). Energy Information Administration). 21 Aug 1978. 55p. NTIS, PC A04/MF A01.

Five energy scenarios selected for use in the Administrator's Annual Report, reflecting assumptions about economic growth and energy supply, give rise to alternative states of the aggregate economy. Shifts in the level and composition of final demand for the economy imply different structures of industrial output with concomitant effects on the level and composition of employment. The implications which the five energy scenarios have for the structure of employment in the US economy for 1985 are examined. The first section discusses the model and simulation procedures used to derive sector employment levels and discusses the limitations of the approach. The second section presents a discussion of the generic relationship between changes in the level and composition of final demand and the effects of such changes on employment. The third section addresses the employment implications of five energy scenarios reported in the Administrator's Annual Report.

55080 (DOE/EIA—0184/12) **Projections of US petroleum supply/demand by quarters through 1980. Analysis report AR/IA/79-37.** Hopkins, F.; Nelson, E.; Sitzer, S.; Wagner, S. (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1979. 49p. Dep. NTIS, PC A03/MF A01.

Revised quarterly projections for 1979 and 1980 for petroleum supply and demand are presented. The revised projections take into account important new developments in the petroleum sector, such as the mid-year OPEC price increases and recent Presidential decisions to accelerate decontrol of domestic crude oil prices and to limit the volume of US petroleum imports, and reflect recent changes in the economic outlook and the availability of petroleum supplies.

55081 **Texas energy development fund. Volume I. Perspectives for RD and D.** Austin, TX; Texas Energy Advisory Council (1977). 57p.

The Texas Energy Development Act of 1977 created the Energy Development Fund to support research in and development of solar, geothermal, lignite, biomass, wind, conservation, and other alternate abundant energy resource technologies. This volume provides an overview of the outlook to the year 2000 from conventional sources of energy in Texas, primarily oil and gas, and further, describes the prospects from developing energy technologies. Legal, technological, economic, and institutional problems impeding the development of each of the developing technologies are identified, and the rationale for project solicitation implied from this overview is described.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 55051, 55132, 55169

55082 (UCRL—50029-79) **Energy and resource planning group. Annual report, FY 1979.** Borg, I.Y. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1979. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

This report summarizes the activities and formal reports of the Lawrence Livermore Laboratory's Energy and Resource Planning Group for FY 1979. A portion of the group's effort was focused on the continued development and perfection of the Energy Policy Model (EPM). An historical check for the period from 1950 to 1970 was conducted. Minor problems encountered during the check have led to model improvements. Acquisition of a data base appropriate to that period promises to facilitate testing of future modifications to the model. The EPM was used to evaluate several reasonable policy options and supply limitations, viz, a nonnuclear scenario and a limited crude-oil-import scenario. A US nuclear phase-out appears to be possible, although severe regional dislocations and power shortfalls are likely. Limiting oil imports, while also possible, requires domestic exploration successes that appear unreasonable in the time frame considered. Members of the group attempted to elucidate various facets of the world energy situation; among them were new factors affecting the supply of oil to the free world, the effect of US regulations on the operation and survival of the OPEC cartel, a limit on the amount of conservation that can be reasonably expected in the transportation sector by 1990, a decline of innovation and productivity in the US, and the possible effect of CO_2 production on future energy options. In addition, the group responded to requests from the DOE and Laboratory management to evaluate the effect of the National Energy Act on the Far West, as well as to continue to implement technology transfer to industry and local governments. 23 references.

55083 **National energy policy: a continuing assessment.** Austin, TX; University of Texas (1978). 400p. University of Texas, Council on Energy Resources, Austin, TX.

The Council on Energy Resources plans to continue a long-run sustained effort that will attempt to combine information from energy research activities and focus this material on energy policy issues. Ten papers are presented here on specific areas of energy policy issues facing the nation. Included are National Energy Policy, September 1977: An Interim Overview by Walt W. Rostow, William L. Fisher, and Herbert Woodson; National Energy Production Requirements and Projections by William L. Fisher, William E. Galloway, and Robert A. Morton; The Impact of Coal Utilization in Texas Under the National Energy Plan by William R. Kaiser and Hal B. H. Cooper; Regional Patterns of Energy Investment, 1977 to 1985 by Allen Davidson and Martin L. Baughman; A Regional Tax Accounting For the National Energy Plan by Allen Davidson and Martin L. Baughman; The Effect on the Economy of Production Cutbacks in the Five Gas-Using Manufacturing Industries by E. Victor Niemeyer and William G. Lesso; Possible State Responses to Federal Regulation of Intrastate Natural Gas by Robert C. Means; Some International Implications of the National Energy Plan by Victor Arnold and John Hamilton; The National Energy Plan and the Leasing of Federal Energy Lands by Hossein G. Askari and Timothy W. Ruefli; The Use of Natural Gas as a Boiler Fuel in Texas to Generate Electricity by John B. Gordon.

55084 **Texas energy issues: 1978. Policy research project report No. 25.** Austin, TX; University of Texas (1978). 128p. (NP—23972). Lyndon B. Johnson School of Public Affairs, Austin, TX.

Several facets of the current energy and related environmental status in Texas are examined. Part I, Permitting and Siting Energy Facilities, contains four chapters: Federal Agencies and Laws Dealing with Energy and the Environment; Siting of Nuclear Waste Disposal Facilities; State Power Plant Siting Authorities; and State Referenda on Nuclear Power Development. Part II, Economics, Financing, and Taxing of Energy, Current Issues, contains four chapters: Effect of Governmental Policies on Texas Oil and Gas Production and Reserves; Price Redetermination in Texas Producer Gas Sales Contracts; Current and Alternative Energy Taxes for Texas; and Horizontal Integration in the Energy Industry. Part III, Economics, Financing, and Taxing of Energy, Transitional Issues, contains three chapters: Boiler Fuel Conversion; Energy Needs of Texas Agriculture; and Role of Government Credit Assistance in Financing New Energy Development. Part IV, Environmental Impacts of Energy Development, contains three chapters: Impact of the Federal Surface Mining Act on Texas Lignite and Uranium Mining; Impact of Prevention of Significant Deterioration Requirements Upon Texas Energy Development; and The Offset Policy in Nonattainment Areas: Implications for Texas. The three chapters in Part V are: Assistance Programs for Energy Impacted Areas; The South Texas Project: A Case Study; and Unit Coal Train Movements to Texas.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 55053, 55055, 55081

55085 (CONF-781094—P2(Summ.)) **Interactive planning workshop. Volume 2. Summary.** (Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Utilization). 1978. 43p. Dep. NTIS, PC A03/MF A01.

From Mt Hood interactive planning workshop; Gresham, OR, USA (15 Oct 1978).

The Division of Fossil Fuel Utilization has sponsored a series of interactive planning workshops designed to involve private citizens and representatives in industry, the academic community, public interest groups, and state and local governments in the division's planning process. The findings of the Mt. Hood Interactive Planning Workshop are presented in this summary. This conclave was held at Timberline Lodge on October 15-17, 1978, and was hosted by the Mt. Hood Community College of Gresham, Oregon. Participants examined the division's program goals, planning process, and project appraisal methodology.

COAL

REFER ALSO TO CITATION(S) 54034, 54098

55086 (DOE/EIA—0183/10) **Energy demand in the developing countries.** Child, J.; Rodekohr, M. (Department of Energy, Washington, DC (USA)). Apr 1979. 20p. Dep. NTIS, PC A02/MF A01.

This paper presents a summary of an analysis of the demand for energy in OPEC and the non-OPEC Developing Countries. While current energy-consumption levels in these countries are relatively small, their future economic growth is expected to be above the world average; therefore, their share of world energy demand is expected to increase. Their relatively high growth rates imply that the energy demanded by these nations will become increasingly important in any future evaluation of Free World energy markets. This paper presents a new model of developing country energy demand which is econometric in nature and is designed to forecast demand for oil, coal, and natural gas - excluding non-fossil fuels. Differences between the model used for the 1977 EIA Annual Report to Congress (1977 ARC) and the new model to be used in the 1978 ARC are discussed, the new model and data used in the analysis are defined, and results generated with the 1978 model and the 1977 model based on identical sets of assumptions are compared.

PETROLEUM

REFER ALSO TO CITATION(S) 54144, 54146, 54147, 55078, 55080, 55086

55087 (DOE/EIA—0011(77-78)) **Monthly petroleum statistics report.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 241p. NTIS, PC A11/MF A01.

Data in the Monthly Petroleum Statistics Report include petroleum imports, motor gasoline stocks, distillate fuel oil stocks, refinery production of petroleum products, and primary stocks of crude oil and petroleum products. The period covered is August 1977 through December 1977.

55088 (DOE/EIA—0013(77-78)) **Heating oil prices and margins.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 22p. NTIS, PC A02/MF A01.

Tabular data on heating oil prices and margins are presented. Heating oil prices are presented by region and for selected states.

55089 (DOE/EIA—0160/77-2) **Crude petroleum, petroleum products, and natural gas liquids in P.A.D. District V.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1977. 49p. NTIS, PC A03/MF A01.

Supply, demand, inventories, and refinery utilization statistics for crude petroleum, petroleum products, and natural gas liquids in P.A.D. District V are presented by month for the period June 1977 through December 1977.

55090 (DOE/EIA—0161(77-78)) **DOE petroleum demand watch.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1978. 102p. NTIS, PC A06/MF A01.

Domestic demand (thousands of barrels per day) data for petroleum products are presented on a 4 week basis for periods ending September 23, 1977 through September 15, 1978.

NATURAL GAS

REFER ALSO TO CITATION(S) 54158, 55086, 55089

55091 (DOE/EIA—0102/30) **Proposed amendments to the entitlements program with respect to imported residual fuel oil.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 68p. NTIS, PC A04/MF A01.

The following modifications to the Entitlements program for residual fuel oil are proposed by the Department of Energy: elimination of the so-called reverse entitlements for domestic refiners selling residual oil into the East Coast in excess of 5000 barrels per day by providing full entitlements runs credits for such sales; and increase in entitlements runs credits for importers of residual fuel oil from the current 30% of the fractional entitlement value applicable to crude oil to 100%, provided the product fee of the Mandatory Oil Import Program has been paid, or 100% minus the value of the product fee if the residual fuel oil is imported under a fee-free license; expansion of the program to all geographical areas historically dependent on imports; and adjustment of entitlements benefits provided to Virgin Islands refiners to offset their competitive advantage vis-a-vis Gulf Coast refiners due to an exemption from the Jones Act granted Virgin Islands refiners.

55092 (DOE/EIA—0103/10) **GASNET: methodology description. TM/ES/78-05.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 4 Aug 1978. 36p. NTIS, PC A03/MF A01.

The methodology description of the natural gas transmission model (GASNET) provides the reader with an understanding of the approach used to develop the projections and the derivation of the equations.

55093 (DOE/EIA—0103/11) **GASNET: user guide. TM/ES/78-11.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 7 Aug 1978. 15p. NTIS, PC A02/MF A01.

This User Guide for GASNET (the natural gas transmission model) will serve as a reference document for preparation of input data and parameters, interpretation of output, and include sufficient information for the program to be executed by an analyst.

55094 (DOE/EIA—0103/12) **GASNET: data description. TM/ES/78-10.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 4 Aug 1978. 43p. NTIS, PC A03/MF A01.

All of the data files for the UPDATE75 program and the GASNET model are described. The description includes both the general format of each file along with the coding scheme utilized.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 54438

55095 (DOE/EIA—0046(77-78)) **Sales, revenue and income for electric utilities, July 1977-June 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). [nd]. 69p. NTIS, PC A04/MF A01.

Detailed summary statistics of sales, revenues, and income for the privately owned utilities for the 12-month period that ended July 1978 is presented. Also with each report is a summary on the twelve-month total sales, revenues, and income ending with the specific month.

55096 (DOE/EDP—0038) **Environmental development plan: electric energy systems.** (Department of Energy, Washington, DC (USA)). Aug 1979. 58p. Dep. NTIS, PC A04/MF A01.

The Environmental Development Plan system is designed to provide a common basis for planning, managing, and reviewing the environmental aspects of the various energy technology programs under DOE's jurisdiction. This EDP addresses the Electric Energy Systems Program, which includes the following programs: electric field effects, underground transmission, high-voltage dc technology, advanced transformer and generator concepts, compact stations, dispersed storage and generation, load management, distribution automation, and complex-systems control. The last three are analytical in nature, and there are no identifiable environmental impacts presently associated with them; thus, they are excluded from this EDP. The remaining technologies are described in Section II. The key projects have been examined in detail to identify their environmental impact and the resulting concerns. The results of these analyses are given in Section III. In Section IV, the management plan for meeting the environmental requirements is identified, along with the organizations responsible for managing the environmental research associated with the EES program.

55097 (DOE/EIA—0004(77-78)) **EIA report on 500 kWh residential electric bills in major cities for October 1977; January, April, and July 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 11p. NTIS, PC A02/MF A01.

A summary of residential electric bills for 40 major US cities for the month of October 1977 is presented. The report is a continuation of quarterly releases issued by the former FPC showing electric bills for 500 kWh of consumption in major cities. Monthly residential use of electricity in large cities averaged approximately 607 kWh during 1976. Similar reports are included for January 1978, April 1978, and July 1978.

55098 (DOE/EIA—0008/77-3) **Quarterly reports: third and fourth quarters 1977 and first quarter 1978. Report to Congress July 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 295p. (DOE/EIA—0008/4(77); DOE/EIA—0008/1(78)). NTIS, PC A13/MF A01.

In the third quarter of 1977, the US produced 1.6% more energy than during the corresponding period in 1976. During the first 9 months of 1977, energy production was up 0.8%. Third quarter net imports of energy increased 10.4% from the level of 1 year earlier. Domestic consumption of energy was 4.2% greater, about the same magnitude as the consumption increases experienced prior to the 1973 to 1974 oil embargo. The US produced 0.5% less energy in the fourth quarter of 1977 than during the corresponding period in 1976. During the 12 months of 1977, energy production rose slightly by 0.2%. Fourth quarter net imports of energy increased 3.7% from the level of 1 year earlier. Domestic consumption of energy was 2.6% lower. The US produced 9.2% less energy in the first quarter of 1978 than during the corresponding quarter of 1977 and 9.5% less energy than was produced during the fourth quarter of 1977. Domestic consumption of energy during the first quarter of 1978 was 3.1% above the level recorded for the same period in 1977, but was 10.5% above that recorded for the fourth quarter of 1977. Net imports of energy for the first quarter of 1978 decreased 11.2% from the first quarter of 1977, but was up 4.8% from the fourth quarter of 1977. Data are specifically tabulated for oil and gas developments, coal, natural gas, petroleum, nuclear energy, and electric power for the periods covered.

55099 (DOE/EIA—0033/2) **Steam-electric plant construction cost and annual production expenses 1976. Twenty-ninth annual supplement.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 251p. NTIS, PC A12/MF A01.

Since the initial publication of this series in 1938, the total installed fossil-fueled steam-electric generation capacity has increased from 26,000 MW to 368,696 MW and the annual net generation from 68.4 billion to 1.53 trillion kWh. The plant investment costs and the 1976 annual production expenses of 679 steam-electric plants in the US and Puerto Rico are presented in some detail. Forty-three of these are nuclear-fueled plants.

55100 (DOE/EIA—0034(77-78)) **Electric power statistics, January 1977-March 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 380p. NTIS, PC A17/MF A01.

Separate monthly summaries of statistics filed by electric utilities for 1977 and January, February, and March 1978 are presented. Data on the following subjects are covered: production of electric energy and capacity of the nation's generating stations by types of prime mover; fuel consumption and fuel stocks on hand at utility-owned electric generating plants; electric utility system loads, showing monthly peak loads and energy requirements of major systems and also semiannual figures on capacity and estimates of peak loads; sales of electric energy to ultimate consumers - including residential, commercial, industrial, and other sales, by states and geographic divisions (includes annual totals for geographic divisions and the continental US); monthly statements of operating revenues and income of privately owned Classes A and B electric utility companies. In the 1977 reports, 1976 data are presented; in the 1978 reports, 1977 data are reported.

55101 (DOE/EIA—0037(77-78)) **EIA report on electric retail rate increases of 366,409,000 annually during third and fourth quarters of 1977 and first quarter of 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1978. 12p. NTIS, PC A02/MF A01.

The report for the third quarter of 1977 shows that 19 electric utilities increased their retail rates by $366,409,000 annually or an average of 8.1% during the third quarter of 1977. Retail rate decreases were reported by two utilities, totaling $47,900,000 annually. The fourth quarter report of 1977 shows that 45 utilities increased their retail rates by $624,697,000 annually or an average of 9.3% during the quarter. Retail rate decreases were reported by four utilities, totaling $3,313,000 annually. The report for the first quarter of 1978 shows that 33 utilities increased their retail sales by $383,607,000 annually or an increase of 6.4% during the quarter. Retail rate decreases were reported by two utilities, totaling $5,042,000 annually. Additional information in the three reports contains comparative data for the previous quarters and the sectors experiencing the rate increases or decreases were noted.

55102 (DOE/EIA—0040/1) **Typical electric bills, January 1, 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 217p. NTIS, PC A10/MF A01.

The survey provides comprehensive coverage of the cost to consumers for representative amounts of electricity used per month for residential, commercial, and industrial service in all sections of the Nation. Bills for residential electrical service are reported for five different energy consumption levels in all communities with populations of 2,500 or more. For commercial and industrial service, bills are presented for all large cities. Commercial bills are shown for five combinations of billing demands in kW and monthly consumption levels in kWh; industrial bills cover five billing demands and ten consumption levels. Long-term trends and current levels of average electric bills for residential, commercial, and industrial service for the total United States, for each state and the District of Columbia, and for nine geographic regions are presented. The detailed information on bills for the three types of service in the individual communities as of January 1, 1978 is tabulated. The information on bills for residential service is supplemented with the latest statistics on average annual residential use of electricity in all large cities. Information is based on the 1970 US census data.

55103 (DOE/EIA—0049(77)) **EIA issues preliminary 1977 power production, fuel consumption, and installed capacity data.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 69p. NTIS, PC A04/MF A01.

Statistics for 1977 on electric utiliy and industrial installed capacity and power production are presented. Also included are consumption and stocks of fossil fuels for electric utilities.

55104 (DOE/EIA—0050/78-1) **EIA issues report on monthly electric energy and peak load data, January-March 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 42p. NTIS, PC A03/MF A01.

Major electric utilities in the contiguous 48 states produced and sold to their customers 196.2 million megawatt-hours of electricity in January 1978. Comparisons are made with 1977 data. Net generation data and outage times due to maintenance are tabulated. Detailed tables, graphs, and maps are included. In February 1978, major electric utilities in the contiguous 48 states produced and sold to their customers 173.3 million MWh of electricity. The report in March 1978 shows that major electric utilities in the contiguous 48 states produced and sold to their customers 172.5 million MWh of electricity.

55105 (DOE/EIA—0075) **EIA report on cost and quality of fuels to electric utilities, January-March 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 185p. NTIS, PC A09/MF A01.

A summary of the cost and quality of fossil fuels delivered to electric utility generating plants in the US for the months of January, February, and March 1978 is presented. It includes fuel cost and quality data on a plant-by-plant basis, grouped by state and geographic region. Also contained in the report is information on fuels delivered to peaking units such as combustion turbines, internal combustion engines (diesel), and combined-cycle plants, in addition to steam-electric plant information. Fossil-fueled plants with a combined capacity of 25 MW or greater are covered.

55106 (DOE/EIA—0077) **National electric rate book: Colorado, Georgia, Montana, and Washington.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 36p. (DOE/EIA—0078; DOE/EIA—0079; DOE/EIA—0080). Dep. NTIS, PC A03/MF A01.

Rate schedules for electric service in communities of 2,500 population or more for residential, commercial, and industrial services are presented for Colorado, Georgia, Montana, and Washington. In addition to communities of 2,500 population or over, all towns and villages with populations between 1,000 and 2,500 served under residential rate schedules available in the larger communities are listed. Rate schedules include customers for lighting, heating, power, and other purposes. Rate schedules omitted are those applicable exclusively to resale service, railways, government bodies, agricultural, and rural service.

55107 (DOE/EIA—0102/14) **International energy supply and demand, support documentation for the administrator's annual report, 1977. Analysis memorandum No. AM/IA/78-23.** Kilgore, W.C.; Rodekohr, M.E.; Butler, G.D.; Cato, D.B.; Paul, E.S.; Weigel, H.S. (Department of Energy, Washington, DC (USA). Energy Information Administration). 21 Aug 1978. 164p. NTIS, PC A08/MF A01.

An analysis associated with Chapter 4 (International Energy Supply and Demand) of the EIA Annual Report, Volume II, 1977, is presented. The major areas of analysis include: energy supply, demand, electricity generation, economic growth, and balance of payments, dealing only with international aspects. Specifically, data on coal, natural gas, and petroleum are presented.

55108 (SAND—79-8258) **Some considerations related to capacity credit for central station solar power plants.** Plastiras, J.K. (Sandia Labs., Livermore, CA (USA)). Sep 1979. Contract EY-76-C-04-0789. 38p. Dep. NTIS, PC A03/MF A01.

Solar power plants will incur both mechanical and insolation outages. This work considers the reliability of a solar electric plant by estimating the likelihood that insolation outages will occur on days when system load is likely to be high. Since high electrical load occurs on the hottest days of the year for many utilities (those designated as summer peaking), much insight into solar plant reliability is obtained by analyzing direct normal insolation on these days. The relationship between quantity and reliability of direct normal insolation is examined for sites such as El Paso, Madison, Miami, and Phoenix. The relative impact of mechanical versus insolation specifications is considered for Miami. Finally, the use of geographic dispersion to improve the reliability of electrical generation via solar energy is examined for Phoenix and El Paso.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 54607

55109 (ANL/SPG—16) **Centralizing or decentralizing: the impact of decentralized electric generation.** Asbury, J.G.; Webb, S.B. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

If rising fuel prices or public policy make decentralized electric generation economical for the residential, commercial, and manufacturing sectors, the economies of scale in these sectors will increase. With current technology, some energy users, such as most single-family dwellings, will find it prohibitively expensive to install and use total-energy systems. They will continue to purchase electricity from a central utility, even though a decline in the utility's customers may increase its cost and prices. Other energy users, such as mid-sized manufacturing enterprises, might find it economical to set up their own generating facilities but would still find themselves operating at higher energy costs per unit of output than larger enterprises with more efficient systems. In both cases, decentralized electric generation would work against the smaller energy users, putting them at a disadvantage relative to the larger, more concentrated users. The objective of this paper is not to oppose alternative energy technologies in general or decentralized electric generation in particular. Such technology should be used if it becomes economical. It is false, however, to argue that decentralized generation is desirable because it will decentralize decision-making in the economy. Like carpooling, public transportation, and other measures to reduce energy cost, cogeneration and total-energy systems that make decentralized electric generation economical will also require increased coordination of economic decision-making.

55110 (DOE/EIA—0005(77-78)) **EIA report on preliminary power production, fuel consumption, and installed capacity data, September 1977-June 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1978. 40p. NTIS, PC A02/MF A01.

Statistics on electric utility power production and consumption of fossil fuels for September 1977, and stocks of fuels as of October 1, 1977 are presented. Also, statistics on electricity utility power production and consumption of fossil fuels for October 1977, and stocks of fuels as of November 1, 1977 are presented. Additionally, statistics on electric power production and consumption of fossil fuels for November 1977, December 1977, January 1978, February 1978, March 1978, April 1978, May 1978, and June 1978 are tabulated and stocks of fuels for the 1st day of the following months are given for each time period.

55111 (DOE/EIA—0010/2) **EIA annual report on monthly comparisons of peak demands and energy for load: 1973 to 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 23p. NTIS, PC A02/MF A01.

Monthly comparisons of peak demands and energy for load are presented. Data are tabulated and graphs prepared indicating monthly summaries of net energy for load and peak demand for each of the eight DOE statistical regions for the 1973 to 1977 period.

55112 (DOE/EIA—0041(77)) **EIA issues quarterly report on national trends in electric energy resources use: first, second, third, and fourth quarters 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1978. 149p. NTIS, PC A07/MF A01.

Summaries of the national trends in the use of electric energy resources for the production of electric power for the first quarter of 1977 shows that electric power generation was 5.8% higher than that for the first quarter of 1976. A second report for the second quarter of 1977 indicates that power generation was 4.7% greater than generation in the second quarter of 1976 and about 4.1% less than that of the first quarter of 1977. Production of electric power for the third quarter of 1977 was up 6.2% over the same period in

1976. Net generation production in the fourth quarter of 1977 as compared to that of a year earlier was up 0.2%. Total electricity produced in 1977 increased 4.2% over electricity production in 1976. Tabulated data and graphs permit trend comparisons for 1976 and 1977 for six units of information: net generation; fuel consumption and stockpiles; fuel deliveries; fuel costs; monthly net energy for load and monthly peak loads by regional reliability councils; sales of electric energy.

55113 (DOE/EIA—0052) **EIA issues power production, generating capacity data for 1972 to 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 25p. NTIS, PC A02/MF A01.

Statistics on trends in electric power production, generation capacity, and consumption of fossil fuels over a six-year period, 1972 through 1977, are presented.

55114 (DOE/EIA—0095(77)) **Inventory of power plants in the United States.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1977. 385p. NTIS, PC A17/MF A01.

The inventory of power plants provides a ready reference for planners whose focus is on the state, standard Federal region, and/or national level. The inventory is compiled alphabetically by state within standard Federal regions. The units (existing and projected electrical generation units, jointly owned units, and projected construction units) are listed alphabetically within electric utility systems which in turn are listed alphabetically within states. The locations are identified to county level according to the Federal Information Processing Standards Publication, Counties and County Equivalents of the States of the United States. A map and a table indicate the states in each Regional Electric Reliability Council and total US generation exiting and forecasted capacity is presented in graphs.

55115 Development of a multi-attribute value function for long-range electrical generation expansion. Moskowitz, H.; Evans, J.; Jimenez-Lerma, I. West Lafayette, IN; Purdue University (1978). 44p. (NP—23975).

Long-range-expansion planning of generation facilities for electric utilities is an extremely complex problem for several reasons. One of the major reasons for complexity is the multiple objective nature of the problem. The two most prevalent objectives in generation planning involve: (1) minimizing the discounted capital and operating costs of the system over some planning horizon; and (2) maximizing some measure of reliability over the planning horizon. Commonly, only the first objective is considered explicitly, while the second objective is treated implicitly, by means of a constraint placed on the measure of reliability (e.g., loss-of-load probability, reserve generation capacity). In this paper, a multi-attribute value (MAV) measurement technique due to Keeney and Raiffa is employed and demonstrated, and a MAV function for generation-expansion planning is identified, containing attributes of: (1) loss-of-peak-load probability for each time period (e.g., 1 year) of the planning horizon for a proposed generation system; and (2) total discounted capital and operating costs over a planning horizon for a proposed generation system. This MAV function is developed through interaction with planning department personnel (decision maker) of a midwestern electric utility company. Indications are given as to how this value function can be interfaced with optimization models for generation-expansion planning and to the feasibility of extending the function to consider attributes concerned with, e.g., environmental degradation and other social factors. 19 references.

55116 (DOE/EIA—0010/1) **EIA report on monthly comparisons of peak demands and energy for load: 1972 to 1976.** (Department of Energy, Washington, DC (USA). Energy Information Administration). [nd]. 23p. NTIS, PC A02/MF A01.

Growth in net energy for load and peak demand for the year 1976 was considerably greater than that experienced during the two-year period subsequent to 1973, though still below historic growth rates. Summary tables from electric utility systems of net energy for load and peak demand for each of the eight DOE statistical regions for the 1972 to 1976 period are given. Historically, electric power loads have been growing at an average annual rate of about 7%, resulting in a doubling of loads about every ten years.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 54624, 54628, 55052

55117 (DOE/EIA—0051(77)) **EIA issues annual summary of electric transmission line data for 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1978. 8p. NTIS, PC A02/MF A01.

Transmisssion line circuit mileage data for both new and existing lines are presented. Also included are the circuit mileage of transmission lines under construction and proposed for installation in the next six years but not yet under construction.

55118 (ORAU—142) **Impacts of transmission lines on birds in flight.** (Oak Ridge Associated Universities, Inc., TN (USA)). Jun 1978. Contract EY-76-C-05-0033. 218p. (CONF-780129—). Dep. NTIS, PC A10/MF A01.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

The current state of knowledge was reviewed and information drawn together on the impacts of power transmission lines on birds in flight at a workshop sponsored by the National Power Plant Team of the US Fish and Wildlife Service and by the Oak Ridge Associated Universities. The workshop addressed three major areas of the problem of flying birds striking transmission lines and structures: its magnitude, possible short-term solutions, and the best future long-term approaches. Brief summaries from the following Working Groups are presented in one section: behavior, habitat, mitigation, management options, and research needs. A separate abstract was prepared for each of six prepared papers, as well as for the keynote address, and a selected bibliography. Two papers had been processed earlier.

55119 (ORAU—142, pp 5-13) **Impact of transmission lines on birds (and vice versa).** Willard, D.E. (Indiana Univ., Bloomington). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

A study of the literature reporting the physical effects of birds colliding with transmission lines seems to indicate that fatalities are insignificant compared to the deaths caused by botulism and hunting, but also that inadequate reporting and species-related factors (biological and political) must be considered. Dead-bird counts under lines and towers do not accurately reflect the results of bird collisions and are too inconclusive to be useful. If siting is planned to protect one species, it may endanger another and require value judgments on the relative merits of different species. Several recommendations suggest approaches to predicting the environmental impacts of power lines on birds and studies that would provide supportive data. 12 references.

55120 (ORAU—142, pp 51-92) **Transmission line wire strikes: mitigation through engineering design and habitat modification.** Thompson, L.S. (Montana Dept. of Natural Resources and Conservation, Helena). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

Recognition that power-line siting may pose a threat to migratory bird populations is fairly recent, although bird kills from collisions have been documented for over a century. While the factors causing and influencing wire strikes are difficult to quantify, the available documented information is presented on the indicated causes of mortality (wire strikes or electrocution) and the types of wires (distribution, fence, transmission, telegraph or telephone, or unspecified) involved in the deaths of birds representing 80 species. The flocking behavior of large water birds makes them especially vulnerable. Other factors are the bird's age and experience, weather and visibility, the presence of adjacent habitat, and wire configurations. Suggestions are made for changing the siting and engineering design of towers and wires and for modifying habitats and flight patterns to minimize the hazards. The costs and benefits of these measures need further study and evaluation. 64 references.

55121 (ORAU—142, pp 93-116) **Effects of transmission lines on bird flights: studies of Bonneville Power Administration lines.** Lee, J.M. Jr. (Bonneville Power Administration, Portland, OR). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

The Bonneville Power Administration (BPA) report on the distinguishing features of power transmission towers and lines and their effect on bird flight and bird kills from collision is based on a literature study and observations made when specific information was needed for environmental-impact statements. The study compares the configurations of different types of lines, describes corona and audible noise effects, and classifies bird-kill data. No significant mortality factor is evident in the preliminary data, although the potential hazard must be acknowledged in siting areas where threatened or endangered birds may collide with wires. Several areas of multidisciplinary studies are needed to develop more detailed information on bird biology, flight, transmission lines, and the environment before conclusions can be reached upon which decision makers can act with confidence. 28 references.

55122 (ORAU—142, pp 129-141) **Transmission-line engineering and its relationship to migratory birds.** Miller, W.A. (Tennessee Valley Authority, Chattanooga). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

Transmission-route selection and transmission-line design are identified as the only two transmission-engineering operations in which bird-collision hazards should be addressed. The transmission-route selection process followed by the Tennessee Valley Authority is described as one which tries to be sensitive to potential problems and to avoid those areas where problems are most likely to occur. Flexibility is encouraged in the design of lines and support structures and in the choice of materials, within the bounds of engineering and economic constraints.

55123 (ORAU—142, pp 143-148) **Routing transmission lines through water bird habitat in California.** Colson, E.W.; Yeoman, E.H. (Pacific Gas and Electric Co., San Ramon, CA). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

The Pacific Gas and Electric Company suggests that studies of the impact that existing and proposed projects will have on migratory water fowl be a cooperative undertaking by the utility industries and environmental agencies to develop a predictive model. The three current areas of concern for PG and E are the Stanislaus Nuclear Power Plant Project, the San Francisco Bay Area Combined-Cycle Project, and coal power plants, each of which will involve siting major transmission lines through water bird habitats.

55124 (ORAU—142, pp 149-165) **Klamath Basin case.** Luman, I.D. (Bureau of Land Management, Portland, OR). Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

Examples along the proposed route of a transmission line from Wyoming to load centers in the Pacific Northwest illustrate the potential impact on the migration routes and the breeding and wintering habitats of waterfowl. Of particular concern is the effect on the mass-feeding flight within the Klamath Basin, where bird losses can be expected from collision with the facilities. Towers will not be placed in the open expanses of water or marshland used by the waterfowl, but other hazards were felt to be unavoidable. The Department of Interior will apply for an alternate route or, if that fails, will mitigate the impact by using underground installations in the critical area. (11 references)

55125 (ORAU—142, pp 201-206) **Selected bibliography on bird mortality involving overhead wires.** Dailey, N.S. (Oak Ridge National Lab., TN); Avery, M.L. Jun 1978.

From U.S. Fish and Wildlife Service workshop; Oak Ridge, TN, USA (Jan 1978).

A bibliography of selected reports dealing with bird behavior and mortality in the vicinity of power transmission wires and structure lists 58 references available from the Ecological Sciences Information Center of the Oak Ridge National Laboratory, Oak Ridge, TN 37830. The presence of some foreign reports on the list indicates that other countries are faced with the same problem.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 55044, 55065, 55066, 55067, 55068, 55069, 55070, 55071, 55072, 55073, 55074, 55075, 55076, 55163, 55164, 55165, 55167

55126 (DOE/EIA—0192) **Federal Energy Data System (FEDS) Statistical Summary Update.** Galliker, J.P. (Department of Energy, Washington, DC (USA). Office of Consumption Data System). Jul 1979. 854p. Dep. NTIS, PC A99/MF A01.

The Federal Energy Data System Statistical Summary Update displays state level energy consumption by major economic sectors for the years 1960 to 1977. The data are displayed in both calorific units (trillion Btu) and physical units. The first half of the publication displays the data in trillion Btu and the second half displays the data in physical units. This publication a revision of the Federal Energy Data System Statistical Summary which was published in February 1978. This updated version includes revised 1975 data and the addition of 1976 and 1977 data. Additional fuels have been broken out in the Update, i.e., highway gasoline in the transportation sector; kerosene in the residential sector; coking coal and petroleum coke in the industrial sector; and diesel in the transportation sector.

55127 **Energy, food, and the consumer.** Rawitscher, M.; Mayer, J. (Tufts Univ., Medford, MA). *Technol. Rev.;* **81**: No. 8, 45-52(Aug 1979).

Energy inputs of the US food industry are analyzed to identify opportunities for conservation. The analysis concentrates on three areas of use: the energy used to operate machinery and equipment, the energy embodied in food production materials, and the energy used to make machinery and equipment. With thirty percent of the total energy associated with food consumed in the home, the opportunities for consumer savings are large. Consumers who understand the energy needed to produce a gram of protein in various food forms and the energy savings available from careful food substitutions can affect the total energy used by their selections at the supermarket. Among the substitutions suggested are fish and bread for beef and either slow simmering or pressure cooking for baking. 13 references.

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 54438, 55064, 55081

SOLAR

REFER ALSO TO CITATION(S) 54292, 54293, 54294, 54328, 54329, 54370, 54384, 54431, 54435, 54436, 54470, 54475

GEOTHERMAL

REFER ALSO TO CITATION(S) 54510, 54566, 54567, 54577, 54588

OTHER

REFER ALSO TO CITATION(S) 54624

55128 **Using wood for fuel: an engineer's view.** Bloomfield, R. pp 77-88 of Wood chips for fuel and energy. Albany, NY; Legislative Commission on Energy Systems (1978).

From Conference on wood chips for fuel and energy; Potsdam, NY, USA (11 Jan 1978).

Mr. Bloomfield, a registered P.E. of Deerfield, NH, examines some of the conversion costs, air pollution, fuel-system integration, and other factors involved in the use of wood residues as an industrial fuel in the US Northeast. Basic consideration is given to a physical description of the wood residue - its bark, previous treatment, particle size, bulk density, and moisture content. The quantity and source of the wood wastes and the form that the converted energy will take must then be considered. Suggestions are made for planning a system conversion, estimating present and future savings, and obtaining maximum operating efficiency with minimum pollution.

55129 **Wood-combustion systems.** Bloomfield, R.G. pp 89-103 of Wood chips for fuel and energy. Albany, NY; legislative Commission on Energy Systems (1978).

From Conference on wood chips for fuel and energy; Potsdam, NY, USA (11 Jan 1978).

Several systems for burning wood residues are described: the dutch oven with pile burning; thin-bed systems on stationary grates; traveling grates; water-cooled grates; refractory-hearth burning; suspension burning; combinations of suspension and burning on different types of grates or hearths; gas-pyrolysis; and fluidized-bed combustion. The choice of a system depends on the physical properties and availability of the residue to be burned and the moisture content of the fuel. The total combustion system must be taken into consideration as well as the firing system. The operation and relative advantages of various systems are described in terms of these factors as they apply in the Northeast.

55130 **Walkthrough of a conversion.** Babcock, G. (Harden Furniture Co., McConnellville, NY). pp 105-130 of Wood chips for fuel and energy. Albany, NY; Legislative Commission on Energy Systems (1978).

From Conference on wood chips for fuel and energy; Potsdam, NY, USA (11 Jan 1978).

Mr. Babcock of Harden Furniture, a vertically integrated furniture company, shares their experiences in planning a waste wood-fueled boiler. Formulas are developed for estimating the quantities of wood waste available for fuel purposes and the economic value of the materials. The combustion system was closely monitored to determine energy requirements and obtain enough data to select the best system. A step-by-step review of the planning and construction stages includes some of the problems encountered during the start-up period. A technological challenge is made to develop a way of producing electricity directly from carbon fuels and a way to eliminate the pollution and fire hazards from stored ground wood products.

55131 **Financing wood-burning systems.** Williamson, T. (State Univ. of New York, Plattsburgh). pp 131-135 of Wood chips for fuel and energy. Albany, NY; Legislative Commission on Energy Systems (1978).

From Conference on wood chips for fuel and energy; Potsdam, NY, USA (11 Jan 1978).

Two types of financing are described: loans to businesses and grants to public organizations who are considering the use of wood as a fuel. Although government grants are presently limited to the

more exotic projects, suggestions are made for making the contacts and putting together a financing proposal. A thorough understanding of each agency's goals and interests is recommended as a way to increase the chances of acceptance.

55132 Wood's role in the National Energy Plan. Bagdon, M. (New York State Energy Office, Albany). pp 137-142 of Wood chips for fuel and energy. Albany, NY; Legislative Commission on Energy Systems (1978).

From Conference on wood chips for fuel and energy; Potsdam, NY, USA (11 Jan 1978).

The four-stage process outlined in the Energy Supply and Environmental Coordination Act (ESECA) of 1974 for fuel conversions at certain oil and gas-burning facilities has been too burdensome to implement, but new legislation is designed to speed up the process by shifting the burden of proof onto the owner of the installation. The role of wood as an alternative fuel can be significant, although small, because of the economic advantages of lower pollution costs and the use of a domestic, renewable fuel. Tax and other financial incentives contained in the National Energy Plan are noted.

55133 Forestry report of the Black River - St. Lawrence Resource Conservation & Development Project. pp 165-171 of Wood chips for fuel and energy. Albany, NY; Legislative Commission on Energy Systems (1978).

From Conference on wood chips for fuel and energy; Potsdam, NY, USA (11 Jan 1978).

The forestry committee of the Black River - St. Lawrence Resource Conservation and Development Project advocates the development of markets for regionally available and currently underutilized forest products. The development of such markets would be beneficial to local woodlot owners, independent timber harvesters, wood-using industries, maple syrup producers, the local economy, and would be of significant benefit to the forests. The forestry committee applied to the United States Forest Service for, and was granted funds to employ a Wood Marketing and Utilization Specialist (WMUS). The proposal identified four program areas to be investigated: the industrial and institutional use of wood for fuel, the establishment of a log-home industry, the maple syrup industry, and a wood concentration yard. Primary emphasis was given to the Wood for Fuel and Energy concept which has met with considerable interest for a wide range of potential applications. This report describes the WMUS's activities during the grant period and his conclusions, recommendations concerning future programs, and suggestions for helpful legislation.

ENERGY CONVERSION

MHD GENERATORS

REFER ALSO TO CITATION(S) 54029

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 55140

55134 (FE—1542-35) **Report on the MHD performance demonstration experiment, October 1, 1976-September 30, 1977.** Schmidt, H.J.; Garrison, G.W.; Whitehead, G.L.; Henderson, H.L.; Seiber, B.L. (Arnold Engineering Development Center, Arnold Air Force Station, TN (USA)). Mar 1978. Contract EX-76-A-01-1542. 150p. Dep. NTIS, PC A07/MF A01.

The Arnold Engineering Develoment Center (AEDC) has been under contract since December 1973 to modify existing equipment and to design, fabricate, and install new hardware to perform an MHD Performance Demonstration Experiment. The objective of the experiment is to demonstrate that a generator simulating a commercial-sized device can convert 16 to 18 percent of the available thermal energy into electrical power. The fabrication and installation of hardware for the test during the period from October 1, 1976 to September 30, 1977, are described. Prior to October 1976, existing equipment and facilities were renovated and major new hardware was designed and fabricated. In the past year, fabrication of most of the hardware has been completed and assembly of the generator channel and magnet system was started. The assembly of one of the five channel sections was completed and is described. The aluminum force containment structure and coils for the magnet were completed and delivered to AEDC. The magnet assembly was completed up to the installation of the first lower coil pancake (40 turns). An independent structural analysis of the force containment structure was completed and resulted in several minor modifications being recommended. Burner testing was performed without the diagnostics section which was not available and four firings with an accumulated time of 29 sec were performed and the results presented. Burner testing will be continued into the first quarter of next year with additional diagnostic probes.

55135 (FE—1542-36) **MHD high performance demonstration experiment. Quarterly progress report, January 1-March 31, 1978.** (Arnold Engineering Development Center, Arnold Air Force Station, TN (USA)). Apr 1978. Contract EX-76-A-01-1542. 20p. Dep. NTIS, PC A02/MF A01.

The assembly of the magnet continued, the generator channel assembly was completed, and burner testing was resumed. Channel assembly operations were completed approximately two weeks ahead of schedule, even though the operation was approximately four weeks behind schedule at the start of the quarter. At the close of the quarter, seven of the nine upper coil pancakes had been installed and the eighth pancake was in position for final placement on the magnet. Burner testing was resumed; however, only one firing with the traversing pressure probe and electrode test assembly installed was performed.

55136 (INIS-mf—4543, pp v) **Experimental and analytical investigation of an MHD channel window frame.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A common design of a magnetohydrodynamic (MHD) generator channel emphasizes a series of mutually connected window frames providing the support for electrodes and containing the jet of ionized gases. Structurally, a window frame is a rectangular frame with a cross section in the form of a quadrilateral weakened by one or more holes forming the cooling system. Window frames are joined together to make a beam with box cross section by means of shear pins. A typical window frame is subjected to a rather severe environment characterized by large pressure and high temperatures. The main sources of stresses and strains would include static and dynamic gas pressures and thermal fields characterized by large gradients across the thickness of frame members. Somewhat less significant are electromagnetic (Cauchy and Lorentz) forces, coolant pressures, dead weight, and interface forces. In the sequel we will consider only the stresses associated with thermal fields. The actual problem is still a very complex one involving analysis of the heat conduction through the electrode-frame system heated by the gas and cooled by the coolant fluid and determination of stresses (elastic and plastic) in a frame with an irregular cross section. It is quite apparent that the actual stress analysis could easily evolve into an expensive and time consuming effort. This is especially true since the operation can under certain conditions be cyclic in nature. In order to obtain a reasonable qualitative and quantitative insight into the phenomenon, three distinctly different approaches have been used: a large elasto-plastic finite element program was used to determine the stresses in the actual frame, an experiment was performed to establish the stress concentrations around holes needed for the passage of coolant, and a two-bar model was used in order to assess the time dependent behavior of the structure for various loading conditions.

55137 Vapor generator and MHD power plant. Matthews, F.T.; Bozzuto, C.R. (to Combustion Engineering, Inc.). US Patent 4,163,910. 7 Aug 1979. Filed date 31 Jan 1977. 8p.

A magnetohydrodynamic generator discharges its gases to a vapor generator. A portion of the heat discharged to the vapor generator is recovered to elevate the temperature of the combustion air to the MHD burner. The burner discharge of an atmospheric heater further raises the temperature of the combustion air. The MHD exhaust gases passed through the vapor generator and the gases discharged from the atmospheric heater are combined to superheat the generated vapor and feed liquid to the vapor generator.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 55134, 55135

55138 (ANL/IVTAN-JT—2) **US/USSR cooperative program in open-cycle MHD electrical power gneration. Joint test report No. 2: tests in the U-25B facility; MHD generator test No. 3.** Tempelmeyer, K.E.; Sokolov, Y.N. (eds.). (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 220p. Dep. NTIS, PC A10/MF A01.

The third joint test with a Soviet U-25B MHD generator and a US superconducting magnet system (SCMS) was conducted in the Soviet U-25B Facility. The primary objectives of the 3rd test were: (1) to operate the facility and MHD channel over a wider range of test parameters, and (2) to study the performance of all components and systems of the flow train at increased mass flow rates of combustion products (up to 4 kg/s), at high magnetic-field induction (up to 5 T), and high values of the electrical field in the MHD generator. The third test has demonstrated that all components and systems of the U-25B facility performed reliably. The electric power generated by the MHD generaor reached a maximum of 575 kW

during this test. The MHD generator was operated under electrical loading conditions for 9 hours, and the combustor for a total of approximately 14 hours. Very high Hall fields (2.1 kV/m) were produced in the MHD channel, with a total Hall voltage of 4.24 kV. A detailed description is given of (1) performance of all components and systems of the U-25B facility, (2) analysis of the thermal, gasdynamic, and electrical characteristics of the MHD generator, (3) results of plasma diagnostic studies, (4) studies of vibrational characteristics of the flow train, (5) fluctuation of electrodynamic and gasdynamic parameters, (6) interaction of the MHD generator with the superconducting magnet, and (7) an operational problem, which terminated the test.

55139 (CONF-790640—5) **Study of the U-25B MHD generator system in strong electric and magnetic fields.** Iserov, A.D.; Maksimenko, V.I.; Maslennikov, G.I. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From 18. symposium on engineering aspects of magnetohydrodynamics; Butte, MT, USA (18 Jun 1979).

The third and fourth tests of the U-25B facility have demonstrated that the MHD flow train has operated for over 50 h with little difficulty. Review of the data reveals no significant problems associated with vibration, stress, or fluctuation of the electrical and gasdynamic parameters of the system components. In Test 3, the MHD generator produced a maximum power of 575 kW, a maximum Hall voltage of 4240 V, and a maximum Hall field of 2100 V/m. Inverter loading characteristics indicated that the upstream portion of the channel operated at low conductivity compared to the two downstream sections. During Test 4, at a lower mass flow rate but with cesium seed and oxygen enrichment to 60%, a power level of about 400 kW was generated. Because of inadvertent water and air leakage into the combustion chamber, however, combustion temperatures were lower in Test 4 that anticipated. These factors had a detrimental effect on the generator performance. Analysis of the data obtained from Tests 3 and Test 4 illustrates that in order to increase the power of the U-25B channel, a number of steps should be taken to increase the effective plasma conductivity and channel mass flow. For example, increasing the mass flow rate to 5 kg/s and achieving a K/sub σ/ of 0.7 to 0.8, a channel inlet temperature about 2950 K may produce an electrical power output up to 1.3 MW. Steps are being taken to increase the preheat temperature in the facility, as well as to eliminate all water and air leakage into the combustor and decrease other thermal losses in the combustor nozzle and generator.

MATERIALS, COMPONENTS, AND AUXILIARIES

55140 (ANL/MHD—78-11) **Technical support for open-cycle MHD program. Progress report, April-June 1978.** Bomkamp,D.H. (ed.). (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 76p. Dep. NTIS, PC A05/MF A01.

The support program for open-cycle MHD at Argonne National Laboratory is developing the analytical tools needed to investigate the performance of the major components in the combined cycle MHD/steam power system. The analytical effort is centered on the primary components of the system that are unique to MHD and also on the integration of these analytical representations into a model of the entire power producing system. The project activities currently include modeling of the combustor, MHD channel, slag separator and the high temperature air heater. In addition, these models are combined into a complete system model which is presently capable of carrying out optimizations of the entire system on either thermodynamic efficiency or cost of electrical power. Also, in support of other aspects of the open-cycle program, test plans are developed and facility and program reviews are provided upon request to support the needs and requirements of the DOE/MHD Division.

55141 (FE—1760-30) **Development program for MHD direct coal-fired power generation test facility. Quarterly technical progress report, July-September 1977.** Dicks, J.B. Jr.; Markant, H.P.; Attig, R.C. (Tennessee Univ., Tullahoma (USA). Space Inst.). 15 Oct 1977. Contract EX-76-C-01-1760. 67p. Dep. NTIS, PC A04/MF A01.

Tests conducted in the existing MHD facility supported areas critical to the design of components for the new intermediate-size, direct coal-fired MHD development facility. A new combustor design concept was developed and tested. In the coal to oxygen ratio studies, equilibrium combustion calculations of the combustion process were carried out for various values of oxidant ratio. This was done to better understand the tradeoffs between satisfactory MHD generator performance and acceptable NO/sub x/ emissions. To improve inverter efficiency, the criteria for specifying filtering of the MHD channel's voltage and current output is defined. Dynamic combustor pressure measurements are discussed. The two-dimensional time dependent calculations of MHD generators presented is an attempt to develop a computer program which will enable the investigation of several types of problems occurring in a combustion gas driven MHD generator. The establishment of a chemical and fuels laboratory is defined. The status of the construction of the new MHD development facility is reported. The materials program reports on the statistical analysis of coal samples. Experiments were performed to determine the feasibility of plasma spraying various coatings on copper, and to optimize the spraying conditions for the various coatings. Visits were made to other materials laboratories in order to formulate a materials research plan at UTSI. A new electrode system was designed to allow better control of the insulator-wall temperatures so that in situ wall slag electrical conductivity can be measured under more refined control conditions.

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 54095, 55134, 55135, 55139, 55140

55142 (ANL/MHD—79-1) **Experimental two-phase liquid-metal magnetohydrodynamic generator program. Final report, October 1977-September 1978.** Petrick, M.; Fabris, G.; Pierson, E.S.; Fischer, A.K.; Johnson, C.E.; Gherson, P.; Lykoudis, P.S.; Lynch, R.E. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 211p. Dep. NTIS, PC A10/MF A01.

The experimental results presented satisfy one major goal in demonstrating the technical feasibility of two-phase LMMHD (liquid-metal MHD), i.e., operating an MHD generator at power densities equal to or above that anticipated for practical power systems. Power densities of up to 32 MWe/m^3 and efficiencies higher than 0.6 at high void fractions were attained for a small 20-kWe generator. Slip ratio data, and more-extensive pressure distribution and voltage profile data are also given. Barium has been identified as an attractive additive for the generation of foams with NaK, and bismuth is a back-up for barium. A guiding hypothesis for understanding the phenomena contributing to foamability in liquid metal systems has been developed, and basic data on surface tension obtained. A computer code has been developed that will calculate the electrical end loss for any insulating vane geometry and magnetic flux density distribution, a significant accomplishment. Initial studies with this code have shown that generator efficiencies in excess of 0.8 are attainable. Initial measurements of local flow parameters in a NaK-nitrogen two-phase liquid-metal MHD generator, using hot-film and resistivity probes, are reported. Although the results are preliminary, there is evidence that large electromagnetic force densities have a significant effect on the sixze and distribution of the gas bubbles or voids. All results are very encouraging for the development of large high-efficiency LMMHD generators.

55143 (FE—2341-10) **High magnetic field MHD generator program. Quarterly report, September, 1978.** Eustis, R.H.; Kruger, C.H.; Mitchner, M.; Self, S.A.; Koester, J.K. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Oct 1978. Contract EX-76-C-01-2341. 38p. Dep. NTIS, PC A03/MF A01.

A series of experiments was conducted in the Stanford M-2 generator to investigate plasma non-uniformities and instabilities. Excellent agreement was obtained with earlier results which showed an increase in property fluctuations with increasing current and magnetic field compared to values without current or magnetic field. Data were taken over a much wider range of conditions than earlier and are only partially reduced at this time. Luminosity measurements which indicate plasma conductivity were made and fluctuations have been correlated with pressure, current, and electric field fluctuations. The correlation is strongest with current. The predominately low frequency fluctuations suggest that relatively large scale non-uniformities exist in the generator channel. A Langmuir probe has been used successfully to measure electron density in an MHD channel with the advantage of spatial resolution over line-of-sight averaged methods. Fabrication of the 6 Tesla disk and linear channels is nearing completion.

THERMOELECTRIC GENERATORS

DESIGN AND DEVELOPMENT

55144 **Thermoelectric battery, protected against shocks and accelerations.** Brown, M.H.; Myatt, J. (to United Kingdom Atomic Energy Authority). US Patent 4,162,369. 24 Jul 1979. Filed date 27 Oct 1977. 8p.

In a thermoelectric battery the heat source is suspended on the end of a thermoelectric unit, the other end of which is attached via a heat conducting mass to the casing. A resilient mounting permits resilient rocking of the thermoelectric unit to reduce stress on the unit in the event of shock or acceleration applied to the casing and spring fingers not normally in contact with the heat source or the thermoelectric unit are positioned to arrest the heat source if the assembly rocks more than a predetermined amount.

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

55145 (COO—3056-34) **DOE/JPL advanced thermionic technology program. Progress report No. 34, June-July 1978. Report No. TE4237/4247-19-79.** (Thermo Electron Corp., Waltham, MA (USA)). 1978. Contract EY-76-C-02-3056. 41p. Dep. NTIS, PC A03/MF A01.

The work function of L605, the optimized converter (L605 emitter, nickel collector) performance at various spacings and fixed emitter temperatures, I-V characteristics a sprayed BaO thermionic converter, and characteristics of combustion-heated thermionic devices are presented graphically. Spacing experiments, a particle thermionic converter, and alloy hot shell development are described. A high efficiency conversion experiment using a structured molybdenum-rhenium emitter and nickel collector is discussed. An extensive study of the high temperaure bonding of lanthanum hexaboride is described. (WHK)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 55145

FUEL CELLS

DESIGN AND DEVELOPMENT

55146 (FCR—0571) **Venture analysis case study for on-site fuel cell energy systems. Monthly technical status report No. 3.** Brown, J.D. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Sep 1977. Contract EX-77-C-01-2684. 23p. Dep. NTIS PC A02/MF A01.

The case study for the on-site fuel cell energy system consists of an energy service offering by gas utilities in which all energy needs of individual buildings are provided by energy systems incorporating on-site fuel cell powerplants. With this approach, the gas utility would own the powerplant and recover costs through the consumer's monthly payments. The equipment manufacturer's customers are the gas utilities. The activities during this reporting period have developed the computer programs and appropriate inputs to those programs to define the market model and the extension of that model to the national level. The market characterization is based on established data and will be the foundation for subsequent analyses. While developing the market model for the case study, a preliminary approximate analysis was conducted to indicate gross effects, and to confirm methodology. The market for the on-site fuel cell energy system includes existing and new commercial and light-industrial and multi-family dwellings. To evaluate the market potential and associated value-in-use price for the fuel cell energy system, it is necessary to establish the overall building requirements on an individual basis and to project these results to the national level. A market model was developed, which will provide for energy system comparisons at the individual building level, to project the overall market to the national level. The market model and information inputs required for the analysis are discussed.

55147 (FCR—0589) **Venture analysis case study for on-site fuel cell energy systems. Monthly technical status report No. 4.** Brown, J.D. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 10 Nov 1977. Contract EX-77-C-01-2684. 93p. Dep. NTIS, PC A05/MF A01.

The detailed market model for on-site fuel cell power plants has been completed and the remaining input information developed. Key elements of the input development included definition of the building energy characteristics on a statistical basis, the development of utility rate schedules with an estimate of projected increases, and a projection of the building inventory (square footage) by region and type. The building energy characteristics (thermal and electrical use) were developed utilizing statistical correlations of building energy use in over 500 buildings. The energy use was developed in relation to weather, building type, and other variations. Much of the data for developing the building energy use was collected in the on-site fuel cell program conducted by Power System Division in conjunction with a number of gas utility companies (TARGET Program). Appendix I summarizes the individual buildings included in the data source, describes the nature of the information collected, presents correlations for selected building types, and includes computer printouts of the thermal, electrical and resource consumption of eight individual building types. This information is included to illustrate the nature of the analysis and to provide an additional data source for other studies of building energy use patterns.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 54039, 54040, 54041

55148 (CONF-7810130—4) **Alternate electrolyte compositions for molten carbonate fuel cells.** Ong, E.T.; Donado, R.A.; Li, C.T.; Claar, T.D. (Institute of Gas Technology, Chicago, IL (USA)). 1978. Contract EM-78-C-03-1735. 14p. Dep. NTIS, PC A02/MF A01.

From The molten carbonate fuel cell workshop; Oak Ridge, TN, USA (31 Oct 1978).

Properties of the Li_2CO_3-Na_2CO_3-K_2CO_3 electrolyte system related to cell performance (such as electrical conductivity, gas solubility and diffusivity, surface tension, and viscosity) and cell endurance (such as corrosivity, vapor losses and compatibility with tile support material) are reviewed for the purpose of optimizing the electrolyte composition. Most recent cell performance data on different electrolyte compositions are presented and correlated with the corresponding electrolyte properties. An optimum electrolyte composition regime has been identified and factors that affect both cell performance and endurance are discussed.

55149 **Method of fabricating a fuel cell electrode.** Kohlmayr, G.M.; Stonehart, P. (to United Technologies Corp.). US Patent 4,163,811. 7 Aug 1979. Filed date 10 Apr 1978. 10p.

Electrocatalyst and hydrophobic polymer particles are combined to form an aqueous suspension which is then applied to a conductive substrate to form an electrode. The colloidal chemistry of the suspension of electrocatalyst particles and hydrophobic polymer particles is controlled prior to the application of the suspension to the substrate such as by the incorporation of a sol of a polyvalent metal oxide or solution of a salt of a polyvalent metal into the suspension.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 55047

55150 **Heat transfer in energy conservation.** Goldstein, R.J.; Didion, D.; Gopal, R.; Kreider, K.; Schoenhals, R. (eds.). New York, NY; American Society of Mechanical Engineers (1977). 139p. (CONF-771120—P8).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Nov 1977).

Seventeen papers by various authors are presented. The topics discussed are the many areas of heat transfer in energy conservation systems such as new techniques for measurement of quantities related to heat loss and energy use; monitoring and control instrumentation; potential energy savings in commercial/residential communities; total system design for building envelopes; and heat storage systems. Individual papers are abstracted separately.

BUILDINGS

REFER ALSO TO CITATION(S) 55045, 55106, 55348, 55476

55151 (LA—7950-MS) **Analysis of magnetic refrigeration for air conditioning applications.** Barclay, J.A. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

The report presents an analysis of the principles of magnetic refrigeration with application to air conditioning. A comparison with conventional evaporation-condensation gas cycle devices is presented. Conclusions concerning the applicability of magnetic refrigeration to air conditioning are made.

55152 (LBL—8835) **Thermal performance of insulating window systems.** Selkowitz, S.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 20p. (EEB-W—79-07; CONF-790678—2). Dep. NTIS, PC A02/MF A01.

From ASHRAE society meeting; Detroit, MI, USA (24 Jun 1979).

Energy efficient windows coupled with window management strategies can alter the role of windows from that of an energy drain to a net supplier of energy to the building. This will require effective utilization of winter solar gain and daylight, coupled with reductions in thermal losses. Thermal losses of conventional double glazing are less than those of single glass but fall far short of the lower loss rate of other building elements. Several improvements in window design, which show promise of reducing the window U value to as low as .5 $W/m^2.K$ (.1$Btu/hr.ft^2.°F$) are reviewed. These include the use of: convection suppression in double glazed windows using low conductivity fill gases, with vertical and horizontal partitions; partial evacuation of the air space; transparent heat mirror coatings on glass and on plastic interlayers; movable insulating devices; and air flow

windows. Thermal comfort, cost effectiveness and other non-energy related performance issues are discussed briefly relative to several of the proposed designs.

55153 (LBL—9048) **Simplified procedure for calculating the effects of daylight from clear skies.** Bryan, H.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 34p. (CONF-790916—2; EEB-W—79-08). Dep. NTIS, PC A03/MF A01.

From Annual IES technical conference; Atlantic City, NJ, USA (15 Sep 1979).

A simplified procedure is described for calculating daylight illumination at any point within a room under clear sky conditions, which is consistent with the CIE recommended daylight factor method. The calculation procedure used here separates the light reaching the point being considered into three components: light directly from the sky; light after reflection from external; and internal surfaces. Graphs and tables are developed for these components in order to evolve a calculation procedure which is simple to apply rather than lengthy direct computation from first principles. Finally, a validation case study is presented in order to demonstrate the accuracy of the proposed calculation procedure and to give readers a direct reference for future use.

55154 (LBL—9284) **Building Ventilation and Indoor Air Quality Program. Chapter from Energy and Environment Division annual report 1978.** Kessel, J. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 41p. (EEB-Vent—79-6). Dep. NTIS, PC A03/MF A01.

This is the second annual report on the research activities of the Building Ventilation and Indoor Air Quality (BV/IAQ) Program. The BV/IAQ Program, formed in FY 1977 has grown quite rapidly in response to the need for research on energy efficient building ventilation systems compatible with the health and comfort requirements of building occupants. The BV/IAQ Program is a major component of the Energy Efficient Buildings Program at LBL. This report is divided into three sections. The first section on the Ventilation Program, represents the major part of the BV/IAQ Program. The second section discusses the Indoor Air Quality research. The third section presents the activities of the Hospitals Program, a closely allied program within the Energy Efficient Buildings Program. The Hospitals Program, includes a large study on hospital ventilation requirements.

55155 (ORNL/SUB—7559/1) **Problems associated with the use of urea-formaldehyde foam for residential insulation. Part I. The effects of temperature and humidity on formaldehyde release from urea-formaldehyde foam insulation.** Long, K.R.; Pierson, D.A.; Brennan, S.T.; Frank, C.W.; Hahne, R.A. (Iowa Univ., Oakdale (USA). Dept. of Preventative Medicine and Environmental Health; Iowa Univ., Iowa City (USA). Univ. Hygienic Lab.). Sep 1979. Contract W-7405-ENG-26. 98p. Dep. NTIS, PC A05/MF A01.

The study is concerned primarily with those properties related to formaldehyde and its application as an ingredient in urea-formaldehyde resins. In particular the effects of temperature and humidity on urea-formaldehyde foam are discussed.

55156 (SIB-R—29-1979) **Plants of heat pumps which utilize lakes as sources of heat.** Baeckstroem, B. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). 1979. 33p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

The possibilities to utilize the water in a lake as a source of heat for a heat pump have been investigated. Both economical and technological aspects have been considered. It has been found that the temperature of the water in Swedish lakes during the winter is so low that the lakes will not be suitable sources of heat for heat pumps. The installation of pipes with circulating heat transfer medium will not be profitable with the present prices on electricity.

55157 **Directory of room air conditioners sorted by voltage and capacity.** Sacramento, CA; California Energy Commission (1979). 18p. (NP—23903).

This directory of room air conditioners (including packaged terminal air conditioners) contains information about each model certified prior to May 31, 1979, as complying with the regulations that became effective on November 3, 1977. Standards for room air conditioners appear in two different regulations. The Appliance Efficiency Standards prohibit the sale and offering for sale of room air conditioners which do not meet the standards. The Energy Conservation Regulations for Residential and Nonresidential Buildings prohibit building departments from issuing permits for buildings which will contain room air conditioners that do not meet the standards. The standards in the two regulations are the same and are tabulated.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 54283, 54437, 54445, 54448

55158 (CONS—2156-1) **Financial methods applicable to energy-conserving retrofits for single-family residences.** (National Savings and Loan League, Washington, DC (USA)). Jun 1977. Contract EX-76-C-01-2156. 258p. Dep. NTIS, PC A12/MF A01.

The National Savings and Loan League (NSLL) has been researching techniques that may be used to finance energy-conservation measures in the residential sector. Twelve techniques developed and tested by NSLL are: future-advances clause under open-end mortgages; borrowing against existing savings accounts; home-improvement loans; variable-rate mortgages; second trusts or second mortgages; variable-payment mortgages; balloon-payment mortgages; deferred monthly payments for periods of excessive energy use; renegotiation of terms at set intervals; lower interest rates offered on mortgages in return for lender sharing in equity appreciation of the property; graduated payments; and deferred-interest loans. The testing took place in Pittsburgh, PA. The program consisted of 8 specific tasks, including several directed at different financial innovations for the financing of retrofits. Details are presented on findings; legal research; relationship of utilities to installation of retrofits; financing techniques applicable to retrofits; and national energy program for single-family residences. Some extensive attachments include information on: legal aspects, energy loan advertisements, and potential savings to be realized from various residential retrofit energy-conservation measures.

55159 (DOE/CS/20315—T4) **Technical background paper for utility and performance relative to consumer-product energy-efficiency standards (for proposed energy-efficiency standards).** Coggins, J.L. (Energy Applications, Columbia, MD (USA)). 13 Sep 1979. Contract AC03-79CS20315. 12p. Dep. NTIS, PC A02/MF A01.

This report summarizes an investigation of the relative utility and performance of nine major household consumer products covered by the Energy Policy and Conservation Act. The objective of the investigation was to define the terms utility and performance, to recommend methods for quantifying these two concepts, and to recommend an approach for dealing with utility and performance issues in the energy-efficiency-standards program. Performance of a consumer product is the objective measure of how well, with the expected level of consumer input, the product does its intended job; and utility of a consumer product is a subjective measure, based on the consumer's perception, of the capability of the product to satisfy human needs. Quantification is based on test procedures and consumer-survey methods already largely in use by industry. Utility and performance issues are important in product classification for prescribing energy-efficiency standards. The recommended approach to classification is: prior to setting standards, evaluate utility and performance issues in the most-quantitative way allowed by resources and schedules in order to develop classification guidelines. This approach to utility and performance issues and classification requires no changes in existing Department of Energy test procedures.

55160 (DOE/EIA—0067/1(78)) **Quarterly tracking system: energy using and conservation equipment in homes.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 20p. NTIS, PC A02/MF A01.

The quarterly tracking system surveys energy-using and conservation equipment in single-family detached units and is designed to provide baseline data for monitoring the progress of improving energy conservation in US residential buildings. Data are compiled on percentages installing storm windows and doors, thermal insulation, and money spent on these innovations.

55161 (DOE/TIC—10235) **Home winterization. A technical report.** Smith, T.; Jenkins, J.; Steinhart, J.; DeWinkel, C. (Wisconsin Univ., Madison (USA). Marine Studies Center). Sum 1977. 23p. Dep. NTIS, PC A02/MF A01.

A survey of current literature on retrofitting existing houses for energy conservation and the economics of such retrofitting by a home owner in Wisconsin are presented. It is concluded that investments in energy conservation, such as added insulation and storm windows, have a potentially higher payoff than most other investment opportunities open to the homeowner, that such retrofitting requires quality materials and workmanship to be effective, and that the homeowner can adopt changes in life habits, e.g., lower thermostat settings, which can save large amounts of energy at very low cost. A bibliography of 92 references on energy conservation in space heating is included. (LCL)

55162 (LBL—8894) **Indoor air quality measurements in energy-efficient houses.** Berk, J.V.; Hollowell, C.D.; Lin, C.I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 27p. (EEB-Vent—79-4; CONF-790634—4). Dep. NTIS, PC A03/MF A01.

From 72. annual Air Pollution Control Association meeting; Cincinnati, OH, USA (24 Jun 1979).

The potential impact of reduced ventilation on indoor air quality is being assessed in a field monitoring program by the Lawrence Berkeley Laboratory. Three houses, designed to be energy-efficient, were monitored using a mobile laboratory. Param-

eters measured included infiltration rate, carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, ozone, sulfur dioxide, formaldehyde, total aldehydes, and particulates. The purpose of this program is to determine if energy-efficient ventilation rates are compatible with good indoor air quality. Preliminary results show that although considerable energy savings can be achieved, indoor levels of several pollutants exceed levels found outdoors; however, in general, the indoor levels of most pollutants are still within limits established by ambient air quality standards. Overall indoor air quality depends upon air exchange rates, building materials, and occupant activities.

55163 (NP—23935) **Residential conservation options for Wisconsin: an analysis of residential space heating energy use, 1970 to 2000.** Hershberg, E.L.; Krohm, G.C.; Yingling, J.C. (Wisconsin Dept. of Administration, Madison (USA). Office of State Planning and Energy). Apr 1979. 60p. Dep. NTIS, PC A04/MF A01.

This study examines three weatherization policy options and their impacts on residential-space-heating energy consumption in Wisconsin. The weatherization policies were analyzed with the Wisconsin Residential Energy Model to determine potential energy savings for the state. By comparing the weatherization policy options to a projection of present and future conservation efforts, a quantitative determination of possible energy savings was established. Along with these statewide energy savings projections, a cost benefit analysis was performed to determine representative individual energy savings and payback periods. Finally, a brief discussion of the social benefits that can accrue from weatherization has been included.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 55063

55164 **Saving energy costs in your dealership.** McLean, VA; National Automobile Dealers Association (1977). 27p. (DOE/TIC—10209).

This Energy Guide provides recommendations for automobile dealers to cut the cost of energy in their business establishments. It shows how to recognize and act on energy waste in: interior and lot lighting, space heating, air conditioning, and general plant maintenance. Most of the energy use in auto dealerships is for lighting and heating. Lighting for interiors and outdoor lots may consume 30 to 70% of total energy costs. Heating and air conditioning costs make up most of the remaining energy outlay. These are the major areas of emphasis in this Guide.

55165 (DOE/TIC—10214) **How you can profit from the energy crisis.** (National Association of Furniture Manufacturers, Washington, DC (USA); Southern Furniture Manufacturers Association, High Point, NC (USA)). May 1979. 106p. Dep. NTIS, PC A06/MF A01.

This handbook demonstrates how furniture manufacturers can save on energy costs. Cost to implement, payback period, first-year savings, and 10-year savings are given for 24 recommendations for lighting and space heating, for the building shell, and processing. By implementing half of these recommendations, the typical furniture manufacturer can save thousands of dollars each year in reduced energy costs.

TRANSPORTATION

55166 (CONF-790763—1) **Problems in predicting market response to new transportation technology.** Bernard, M.J. III. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 33p. Dep. NTIS, PC A03/MF A01.

From 4. international conference on behavioral travel modeling; Eibsee, F.R. Germany (2 Jul 1979).

This paper considers the unique problems and existing techniques for forecasting the markets and use patterns of new transportation technologies with respect to those used in typical urban demand modeling for facilities and for network loadings. Problems unique to technology demand forecasting discussed are: (a) determining the future characteristics of the technology, especially performance and cost relative to its competition; (b) determining the correct market segments for the technology and the expected maximum size of each segment; (c) estimating the impact of governmental support to accelerate commercialization and subsidize utilization; and (d) predicting the flexibility of society to change tripmaking patterns and adjust vehicle missions to accommodate vehicles with different performance characteristics. One major problem facing transportation forecasters is accounting for potential behavioral changes due to changing attitudes on energy and environmental constraints. The paper suggests that three success factors can be defined for a new technology. These are based on problems (a) and (b) above and are superior performance and cost relative to competition and large potential markets. These factors correlate highly with recent new transportation-technology successes and failures as the paper points out. Recent US efforts to predict electric-vehicle markets are reviewed relative to overcoming the problems and accounting for the success factors.

55167 (DOT-P—10-78-46) **Trends in Federal domestic transportation programs, revenues, and expenditures by state: fiscal years 1957-1975.** Woodward, C.W. Jr. (Department of Transportation, Washington, DC (USA). Intermodal Studies Div.). May 1979. 304p. Dept. of Transportation, Office of Sect., 400 7th Street, Washington, DC.

This publication represents an updating, refinement, and expansion of the information contained in the report, Estimated Federal Expenditures on Domestic Transportation Capital Improvement and Operating Programs, April 1974. In addition to expenditures, the pesent report includes revenues generated. Also included in this report is a detailed discussion on the historical evolution of Federal transportation revenue and expenditure programs. Federal transportation expenditures and revenues are reported for only transportation capital and operating programs - the intent is to identify and include only those programs which provide some physical development and program funding to the various modal system. The major objectives of the present effort are to identify major sources of transportation program funding; identify and include the major transportation capital improvement programs; provide funding data that would permit realistic comparison with the identifiable receipts; provide the above information in as much detail as possible; and provide a time series of the data to recognize trends.

PIPELINE

55168 (SAN—1171-1) **Energy study of pipeline transportation systems. Executive summary. Final report.** Banks, W.F. (Department of Energy, San Francisco, CA (USA). San Francisco Operations Office). 31 Dec 1977. Contract EY-76-C-03-1171. 54p. Dep. NTIS, PC A04/MF A01.

The basic objectives of the study were to: characterize the pipeline industry and understand its energy consumption, i.e., the patterns of consumption and the quantities and intensities of that consumption in each of the five major pipeline industry segments: gas, oil, slurry, fresh water, and waste water; characterize and understand the influence of the Federal Government on the introduction of energy-conservative innovations into the pipeline industry; identify opportunities for energy conservation in the pipeline industry, and to recommend the necessary programs of research, development, and demonstration to exploit those opportunities; and assess the future potential of the pipeline industry for growth and for contribution to the national goal of energy conservation, including consideration of freight pipelines. Pipelines for crude oil, natural gas, petroleum products, water, coal slurries, and for the pneumatic transport of solids are considered. Information is included on: energy consumption for pipeline transport; energy efficient pumping equipment; methods for reducing drag in pipelines; government regulations related to pipelines; environmental aspects of pipeline transport; and the economic outlook and growth of the pipeline industry. (LCL)

55169 (SAN—1171-3) **Federal regulation of the pipeline industry. A summary review. Technical report, Task 2.** Banks, W.F. (Energy Research and Development Administration, San Francisco, CA (USA). San Francisco Operations Office). 31 May 1977. Contract EY-76-C-03-1171. 123p. Dep. NTIS, PC A06/MF A01.

The principal purposes of this report are to identify the jurisdiction areas of the federal pipeline regulating agencies, and to examine the amenability of the regulatory system to the introduction of energy-conservative new technology into the pipeline industry. The history, scope, and agency structure of state and federal regulation are recounted and some gaps, overlaps, and ambiguities are identified. The only significant inhibitory effects upon technological innovation are found to derive from the FPC and ICC limits upon profit, the 1941 Justice Department consent decree limiting dividends to shipper-owned pipelines, and the income tax rules governing recovery of investment credits and startup losses. Effects of these limits are explored by simulation studies using the Systems, Science and Software pipeline economic model (PEM). Two new concepts of regulation are proposed which would neutralize the inhibitory effect of the present regulatory system and would motivate pipeline operators to conserve energy: one, the use of a national equivalent value in the economic trade-off analyses which justify entry of a technological innovation into the rate base (valuation); and two, a valuation allowance which would reverse the presently often-existing situation and insure that the pipeline operator would realize a greater profit from saving energy than from wasting it.

55170 (SAN—1171-5) **Prospects for energy conservation in the pipeline industry. Technical report, tasks 4 and 5.** Banks, W.F. (Department of Energy, San Francisco, CA (USA). San Francisco

Operations Office). 30 Nov 1977. Contract EY-76-C-03-1171. 78p. Dep. NTIS, PC A05/MF A01.

A qualitative projection (the baseline scenario) is made of the pipeline industry growth to the year 2000. This projection is based on the conventional wisdom of the industry. It is concluded that, to achieve significant growth, the industry must develop the capability, called freight pipeline, to move other commodities than oil and gas, i.e., bulk and packaged goods. Technical and economic performance criteria are identified which, if met by the freight pipeline capability, could induce modal shifts resulting in a reduction of total transportation energy consumption, and would offer other benefits, including compatibility with high-speed rail passenger service.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 55045, 55127

ENERGY SOURCES

REFER ALSO TO CITATION(S) 55129, 55130, 55131, 55132

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 55165

55171 (ANL/CNSV—3) **Energy and materials flows in the fabrication of aluminum products.** Arons, R.M.; Wolsky, A.M. (Argonne National Lab., IL (USA)). Aug 1978. Contract W-31-109-ENG-38. 69p. Dep. NTIS, PC A04/MF A01.

In 1977, 1.5% of all purchased fuels and electricity used by US industry was consumed in the holding, casting, melting, and production of mill products by the aluminum industry. An in-depth understanding of how that energy is used is necessary for the formulation of plans to reduce energy consumption. Similarly, assessment of the relative value of innovative energy efficient processing techniques depends upon a better understanding of current practice. This report describes the aluminum fabrication process in great detail and cites energy use and efficiency for each process step. It is concluded that the most effective approaches to energy conservation would be use of methods for waste heat reduction and recovery, reduction of scrap generation during processing, use of induction heating for both melting and heat treating, and use of alternative processing techniques that eliminate energy intensive intermediate steps.

55172 (ANL/OEPM—79-1) **Survey of potential chlorine production processes. Final report.** (Versar, Inc., Springfield, VA (USA)). Apr 1979. Contract W-31-109-ENG-38. 196p. Dep. NTIS, PC A09/MF A01.

This report is part of the ongoing study of industrial electrochemical processes for the purpose of identifying methods of improving energy efficiencies. A computerized literature search of past and current chlorine generation methods was performed to identify basic chlorine production processes. Over 200 pertinent references are cited involving 20 separate and distinct chlorine processes. Each basic process is evaluated for its engineering and economic viability and energy efficiency. A flow diagram is provided for each basic process. Four criteria are used to determine the most promising processes: raw material availability, type and amount of energy required, by-product demand/disposal and status of development. The most promising processes are determined to be the membrane process (with and without catalytic electrodes), Kel-Chlor, Mobay (direct electrolysis of hydrogen chloride), the Shell process (catalytic oxidation of hydrogen chloride) and oxidation of ammonium chloride. Each of these processes is further studied to determine what activities may be pursued.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 55063, 55130

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54066, 54067, 54068, 54069, 54071, 55051

55173 **Application of high gradient magnetic separation for water treatment in steel industry.** Yano, J.; Eguchi, I. (Daido Steel Co., Ltd., Nagoya, Japan). pp 134-136 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The main design concept in developing high gradient magnetic separation (HGMS) is to achieve high filtration efficiency with small power consumption. HGMS has been applied to various kinds of waste water from steel mills. The results have indicated that HGMS is more effective and economical than other filtration methods for the treatment of waste water containing magnetic particles in terms of operating cost, space requirement, and installation cost, etc. In the course of the application, methods have been developed to properly deal with problems arising from characteristics of such waste water as oil-contained water, calcium-bearing water, water containing large particles, and water containing non-magnetic particles.

55174 **Operation of a full-scale device of high gradient magnetic filter for treatment of gas scrubber water from vacuum degassing process in a steel mill.** Takino, K. (Hitachi Plant Engineering and Construction Co., Inc., Tokyo, Japan); Tankaka, T.; Shichiri, T. pp 137-142 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

A full-scale production device of high gradient magnetic filter (HGMF) was installed in Japan at the end of 1977 for the purpose of removing fine-size suspended solids contained in condenser-cooling scrubber water discharged from vacuum degassing process in a steel mill. As of today, the device has been in operation continuously at the flow rate of 900 m^3/hr with very satisfactory results. Main constituents of the suspended solids in the feed water to HGMF are iron and manganese oxides. The particle size distribution is generally 85% in the range of 5 to 20 microns. The device has an effective filter area of 2.1 meter in diameter and is operated at a flow velocity of 270 m/hr with the magnetic flux density of 0.3 Tesla. The suspended solids in the feed with an average concentration of 100 mg/l are reduced to less than 20 mg/l in the filtrate. The successful operation of this production device has stimulated great interest among the steel mills in Japan and application of this technology for the treatment of other waste water streams in steel mills will soon be initiated.

MUNICIPALITIES AND COMMUNITY SYSTEMS

55175 (BNL—50987) **Decentralized energy: technology assessment and systems description.** Reckard, M.K. (Brookhaven National Lab., Upton, NY (USA)). Jun 1979. Contract EY-76-C-02-0016. 217p. Dep. NTIS, PC A10/MF A01.

Decentralized energy systems and their characteristic features are examined in the report. These systems have been divided into six groups for the purpose of analysis: solar, wind, hydro, biomass, geothermal, and coproduction (total energy). The technical and economic potential for the implementation of these systems is discussed for the years 2000 and 2025. The results of a comparison of base-case and decentralized scenarios for the year 2000, using a computer systems model, are presented. Social and institutional factors are also addressed, both as motivations for and results of energy system decentralization. Appendices are included with more detailed technical information on each of the systems groups.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 55063

55176 (ANL/CNSV-TM—11) **Economic and technical analysis of retrofit to cogenerating district energy systems: North-Central cities.** Santini, D.J.; Davis, A.A.; Marder, S.M. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 395p. Dep. NTIS, PC A17/MF A01.

Six major US cities (Washington, DC, St. Louis, Cleveland, Milwaukee, Detroit, and Chicago) were studied to achieve reasonably accurate estimates of costs required to retrofit them with district energy systems. Demand estimates and energy-supply analyses are made, and component capital costs are estimated to arrive at annualized system costs. Finally, a comparison of alternative energy delivery options is made, and estimates of scarce-fuel savings are derived.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54264, 54279, 55054

55177 (SAND—79-1538C) **Dried gamma-irradiated sewage solids use on calcareous soils: crop yeilds and heavy metals uptake.** McCaslin, B.D.; Sivinski, J.S. (New Mexico State Univ., Las Cruces (USA); Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 27p. (CONF-7905103—1). Dep. NTIS, PC A03/MF A01.

From Energy technology conference on waste irradiation; Hanover, F.R. Germany (2 May 1979).

Experiments designed to examine gamma-radiation effects on extractable and plant-available sludge elements and to examine the response of crops to sludge applications on two typical, calcareous soils in New Mexico are summarized. Information has been given indicating that the radiation process of reducing pathogens in sewage products being developed by Sandia Laboratories, does not significantly increase the chemical extractability and plant uptake of a broad range of nutrients and heavy metals. However, radiation treatment greatly facilitates handling sewage for experimentation, because pathogen contamination precautions are eliminated and weed seeds killed. Studies on the effects of sludge irradiation on plant nutrient uptake revealed no concentration increases, agreeing with results presented herein. Sewage products may have special potential for use on calcareous soils, such as in New Mexico. For instance, in New Mexico the lack of potassium in sewage products is not a problem and the naturally high pH of New Mexico soil greatly reduces plant availability of many problem heavy metals. Dramatic increases in yield are typified by the greenhouse and field results presented herein, especially for the known micronutrient deficient soils of New Mexico. Results indicate that sewage sludge is an excellent Zn and Fe fertilizer. More research needs to be done before the economics of sludge application can be calculated and more field information is needed before irradiated sewage products are used indiscriminately. (ERB)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

55178 (UCID—18266) **Energy storage systems for automobile propulsion: 1978 study workshop, summary and conclusions.** Payne, J.S.; Forsberg, H.C. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Sep 1979. Contract W-7405-ENG-26. 41p. Dep. NTIS, PC A03/MF A01.

A number of short papers and presentations pertaining to the materials presented and the discussions which took place at the Second DOE/LLL Workshop on Energy Storage Systems for Automobile Propulsion are presented. The objectives of the workshop were to foster understanding of energy storage technology as it relates to automobile propulsion, to make the study results available to concerned individuals and organizations, and to obtain feedback to help guide further study efforts. (MCW)

55179 **Twenty-seventh annual conference, IEEE Vehicular Technology Group.** New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977). 274p. (CONF-7703113—).

From 27. IEEE vehicular technology group conference; Orlando, FL, USA (16 Mar 1977).

Separate abstracts have been prepared for the two papers considered in scope for the DOE Energy Data Base. (TFD)

INTERNAL COMBUSTION ENGINES

TURBINE

55180 (COO—4867-4) **Gas turbine engines and transmissions for bus demonstration programs. Technical status report, 30 April 1979-31 July 1979.** Nigro, D.N. (General Motors Corp., Indianapolis, IN (USA). Detroit Diesel Allison Div.). Jul 1979. Contract EM-78-C-02-4867. 5p. Dep. NTIS, PC A02/MF A01.

The quarterly status report covers the period from 30 April 1979 through 31 July 1979 and is a summary of DDA activities for the effort performed on the procurement and delivery of eleven (11) Allison GT 404-4 gas turbine engines and five (5) HT740CT and six (6) V730CT Allison automatic transmissions and the required associated software. The contract requires the delivery of eleven (11) Allison GT 404-4 Industrial Gas Turbine Engines and five (5) HT740CT and six (6) V730CT Allison Automatic Transmissions for the Greyhound and Transit Coaches, respectively. In addition, software items such as cost reports, technical reports, installation drawings, acceptance test data and parts lists are required. A recent decision by the DOE will modify the build configuration for the last four (4) Transit Coach engines. It was decided by the DOE at a meeting in Washington, DC on March 28, 1979 with representatives from DDA, NASA/LeRC, JPL and Booz-Allen and Hamilton that these engines will be built with ceramic regenerators. (TFD)

55181 **Review of the automotive torque converter.** Mercure, R.A. (US DOE, Div of Trans Energy Conserv). *SAE Prepr.;* No. 790046, 1-11(1979).

With the big gains in automobile fuel economy already accomplished, primarily with off-shelf technology, further improvements above that expected by further downsizing will now require advanced technology. One area in which advancing the state of the art may not only benefit fuel economy but preserve driveability is in the fluid dynamic performance of torque converters. Detailed fluid dynamic investigations were performed on a three-element torque converter. These investigations were based on computer solutions that have been successfully applied in the design of gas turbines. The results indicated the presence of negative and highly non-uniform velocities in the impeller. If these negative velocities or backflows could be removed and more uniform velocity gradients could be maintained, higher efficiency should be expected. Recommendations are made for further investigations. 10 refs.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 55027

55182 **Electric vehicle development.** Stevenage, England; Peter Peregrinus Ltd. (1977). 110p. (CONF-7705156—). r.

From Electric vehicle development; London, UK (31 May 1977).

Seventeen papers were presented at the meeting. A separate abstract was prepared for each paper. (RCK)

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 55182

VEHICLE DESIGN FACTORS

ENGINE-TRANSMISSION MATCHING

REFER ALSO TO CITATION(S) 55180, 55181

ENGINE SYSTEM

55183 (SAN—1095-T1) **Final technical study on reduction of automotive accessory power requirements.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 20 Oct 1978. 689p. Dep. NTIS, PC A99/MF A01.

This is the second of two volumes that document a study on the reduction of automotive accessory power requirements. The volume presents the technical aspects of the total funded effort for five program phases including; conceptual design, preliminary design, detail design, fabrication and test, hybrid systems and advanced engine study. (TFD)

MATERIALS

REFER ALSO TO CITATION(S) 54010

55184 (DOE/ER—0031) **Materials Sciences programs. Fiscal year 1979.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Sep 1979. 172p. Dep. NTIS, PC A08/MF A01.

A convenient compilation and index of the DOE Materials Sciences Division program are provided. All projects, funding, and investigators are listed.

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 54011, 54012, 54013, 54014, 54015, 54016, 54017

55185 (NBSIR—79-1609, pp 297-312) **Evaluation of stainless steel weld metals at cryogenic temperatures.** McHenry, H.I.; Read, D.T.; Steinmeyer, P.A. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The influence of ferrite content, ferrite morphology and sensitization on stainless steel weld toughness at cryogenic temperatures was studied. A reduction in toughness at 4°K was indicated. The influence of nitrogen on the strength and toughness of three high strength filler wires at 77°K was evaluated. The results indicate that the strength of each stainless steel alloy increases and the toughness decreases with increasing nitrogen content. AWS 330 test plates were fracture toughness tested at several temperatures. A

series of test weldments were tested for tensile properties and fracture toughness.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 54840, 54841, 54843, 55219

55186 (CONS—2771-T1) **[Development of automated welding process for field fabrication of thick walled pressure vessels]. Technical progress report for period ending June 30, 1979.** (Westinghouse Electric Corp., Tampa, FL (USA). Tampa Div.). 1979. Contract EF-78-C-01-2771. 6p. Dep. NTIS, PC A02/MF A01.

The following activities for this period are reported: five welding processes (GTAW, GMAW, SAW, ESW, and EBW) are reviewed, torch design modifications were completed, improved joint designs were machined, and all wires for the project were ordered. (FS)

55187 (DOE/EIA—0106(77)) **Carbon black in 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 4p. NTIS, PC A02/MF A01.

Carbon black production, shipments, and inventory for July through September 1977 are presented. Salient statistics of carbon black production sales and feedstock in the United States are given for 1976 and 1977.

55188 **Preparation of single crystals of praseodymium and neodymium.** Fort, D.; Jones, D.W. (Birmingham Univ. (UK)); Beaudry, B.J.; Gschneidner, K.A. (Ames Lab., IA (USA)). pp 28-34 of Rare earths and actinides, 1977. Corner, W.D.; Tanner, B.K. (eds.). Bristol; Institute of Physics (1978).

From International conference on rare earths and actinides; Durham, UK (4 Jul 1977).

Previous attempts to grow crystals of Nd and Pr have achieved only limited success. Resultant crystals have been small and of unspecified crystallinity, or if large, have contained considerable substructure. By extending solid state electrotransport (SSE) methods of material refining to include heat treatment, involving thermal cycling about the transformation temperature, high-quality single crystals of both Nd and Pr have been prepared.

55189 (INIS-mf—4881, pp B.V.1-B.V.8) **Topical problems of crackability in weld annealing of low-alloyed pressure vessel steels.** Holy, M. (Statni Vyzkumny Ustav Materialu, Prague (Czechoslovakia)). Oct 1977. (In Czech).

From 17. welding conference CSSR; Strbske Pleso, Czechoslovakia (30 Oct 1977).

The following method was developed for determining annealing crackability: A sharp notch was made in the middle of the bodies of rods imitated in a welding simulator. Chucking heads were modified such as to permit chucking a rod in an austenitic block by securing the nut. Prestress was controlled by button-headed screw adapters. The blocks were made of 4 types of austenitic steels with graded thermal expansivity coefficients, all higher than that of the tested low-alloyed steel rod. The blocks with rods were placed in a furnace and heated at a rate of 100 degC/h. As a result of the larger austenite block diameter the rod began to be stretched and at some temperature of more than 500 degC it was pulled apart. The risk of annealing crackability of welded joints may be reduced by the choice of material and melt and by the technology of welding, mainly by the choice of a suitable addition material in whose weld metal the plastic deformation preferably takes place in annealing.

55190 (INIS-mf—4905, pp 223-251) **Effect of structure defects on corrosion kinetics in irradiated polycrystalline metals.** Gol'tsev, V.P.; Korotov, V.F.; Fedyushin, E.E. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The paper is concerned with the influence of various defects on corrosion kinetics of austenitic chromium-nickel steels in the N_2O_4 - base coolant. It is shown that the high temperature oxidation kinetics is affected mainly by three-dimensional defects such as incoherent inclusions having the shear modulus higher than that of the matrix. The effect of impurity induced defects on the material oxidation as well as different interactions of defects with an elastic dislocation strain field are considered. It is found that in the process of fast particle irradiation the chromium concentration changes near the oxidation surface and this can affect the rate of steel corrosion at different stages of oxidation.

55191 (LBL—8519) **Magnetic fields, current densities, melt velocities and current efficiencies in Hall-Heroult cells: computations and comparison with measurements.** Evans, J.W.; Zundelevich, Y.; Tarapore, E.D.; Sharma, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 27p. (CONF-790937—1). Dep. NTIS, PC A03/MF A01.

From Heat and mass transfer seminar on heat and mass transfer in metallurgical systems; Dubrovnik, Yugoslavia (3 Sep 1979).

The magnetic fields, current densities, metal and electrolyte velocities, and current efficiencies within the Hall-Heroult cells used to produce aluminum have been predicted from first principles. The computation of current densities was carried out by solving Ohms law enabling the calculation of magnetic field vectors from the Biot-Savart law. The cross product of the current densities and magnetic fields then yielded the electromagnetic stirring forces acting on the molten metal and electrolyte. By employing a turbulence model and the time averaged Navier-Stokes equations, velocities within these two liquids could be calculated. Following this the mass flux of aluminum from the aluminum-electrolyte interface could be calculated using an equation due to Levich and subsequently the current efficiency predicted. Predicted field strengths and metal velocities within a 185 kiloamp cell were in approximate agreement with measured values.

55192 (RDT-M—2-11T(8-79)) **Nickel-molybdenum-chromium alloy forgings (ASME SA-182 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 12p. RSO.

This standard covers nickel-molybdenum-chromium alloy forgings for nuclear and associated applications. Material shall conform to the applicable requirements of ASME SA-182 as modified by Code Case 1345; to the applicable requirements of the ASME Boiler and pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

55193 (SAND—79-8038) **Plating on titanium for electrochemical joining applications.** Dini, J.W.; Johnson, H.R. (Sandia Labs., Livermore, CA (USA)). Sep 1979. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

Ring shear tests were used to evaluate the adhesion of electroplated nickel on titanium. Different plating processes were investigated. Shear strengths as high as 299 MN/m^2 (43,300 psi) were obtained. By utilizing the best processes as indicated from these tests, some titanium parts with machined tapers were then successfully joined to one another and to a uranium alloy (mulberry) with thick nickel plating.

55194 (RDT-M—3-18T(8-79)(Rev.)) **Nickel-molybdenum-chromium alloy seamless tubes (ASME SB-163 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 10p. RSO.

This standard covers nickel-molybdenum-chromium alloy seamless tubes for nuclear and associated applications. Material shall conform to the applicable requirements of ASME SB-163 as modified by Code Case 1345; to the applicable requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

55195 (RDT-M—3-27T(8-79)(Rev.)) **Seamless and welded small diameter austenitic stainless steel tubing (ASTM A 632 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 13p. RSO.

This standard covers seamless and welded small diameter austenitic stainless steel tubing for nuclear and associated applications. Material shall conform to the requirements of ASTM A 632; to the applicable requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000 as further defined herein; and to the additional requirements of this standard.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 54841, 55208, 55209, 55273, 55274, 55279, 55280, 55285, 55286

55196 (CONF-7906103—3) **Martensitic phase transformation in shape-memory alloys.** Golestaneh, A.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From International conference on martensitic transformation; Boston, MA, USA (24 Jun 1979).

Isothermal studies are described of the shape-recovery phenomenon, stress-strain behavior, electrical resistivity and thermoelectric power associated with the martensite-parent phase reaction in the Ni-Ti shape-memory alloys. The energy-balance equation that links the reaction kinetics with the strain energy change during the cooling-deforming and heating cycle is analyzed. The strain range in which the Clausius-Clapeyron equation satisfactorily describes this reaction is determined. A large change in the Young's modulus of the specimen is found to be associated with the M → P reaction. A hysteresis loop in the resistivity-temperature plot is found and related to the anomaly in the athermal resistivity changes during cyclic M → P → M transformation. An explanation for the resistivity anomaly is offered. The M structure is found to be electrically

negative relative to the P structure. A thermal emf of ≧ 0.12 mV is found at the M-P interface.

55197 Studies of californium metal at high pressure by x-ray diffraction. Burns, J.H. (Oak Ridge National Lab., TN (USA)). pp 52-54 of Rare earths and actinides, 1977. Corner, W.D.; Tanner, B.K. (eds.). Bristol; Institute of Physics (1978).

From International conference on rare earths and actinides; Durham, UK (4 Jul 1977).

The behaviour of the crystal structure of californium metal under various pressures up to 14.0 GPa has been studied by use of a diamond-anvil type of miniature x-ray diffraction camera. Ten-microgram samples were encapsulated in aluminium foil, which also served as an internal standard for pressure determination. The phase transitions in cerium metal were produced and identified as a test of the apparatus and technique. Californium metal samples in the low-density FCC form (asub(o)= 5.75A) and in the high-density FCC form (asub(o)= 4.96A) were each subjected to high pressure, but no transition was observed from one phase to the other. On release of the pressure, the lattice constant returned to its original value. Approximate values of the compressibility were obtained; they are both approximately 7×10^{-7} cm^2 kg^{-1}.

55198 (INIS-mf—4905, pp 52-68) **Method of evaluating point defect interaction radii from calculations of dynamic crystal characteristics.** Zhukov, V.P.; Kapinos, V.G.; Kevorkyan, Yu.R. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

A mechanism of defect migration in the presence of an interstitial atom following from the representation of a diffusion jump as a result of an amlitude fluctuation of normal oscillations of an imperfect crystal atom is considered. 3N classical differential equations of atomic motion (N being the total number of atoms in the crystal) were solved with a computer using Born-von-Karman method. In the considered example the calculation was made for iron crystallite (N=116) with one atom of carbon. 11 oscillatory modes with frequencies exceeding that of a base spectrum were obtained, most of them favouring the occurrence of the diffusion jump. Radius values of defect trapping lie within 1-5 lattice constants.

55199 (LA-UR—79-2261) **Time correlation of random moments in spin glass CuMn observed by zero-field muon spin relaxation.** Yamazaki, T.; Uemura, Y.J.; Takagi, M.; Huang, C.Y. (Tokyo Univ. (Japan). Dept. of Physics; British Columbia Univ., Vancouver (Canada). TRIUMF Facility; Tokyo Univ. (Japan). Inst. for Solid State Physics; Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790909—4). Dep. NTIS, PC A02/MF A01.

From International conference on magnetism; Munich, F.R. Germany (Sep 1979).

The correlation times of random moments in CuMn (0.8 and 0.5 at. %) have been obtained from the zero-field spin relaxation of positive muon. The correlation time has been found to vary rapidly in a very wide range from 10^{-6} to 10^{-10} sec in the temperature region 0.5T/sub g/ ≦ T ≦ 1.5T/sub g/.

55200 (LBL—9346) **Computer simulation of the martensite transformation in a model two-dimensional body.** Chen, S.; Khachaturyan, A.G.; Morris, J.W. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 10p. (CONF-7906103—1). Dep. NTIS, PC A02/MF A01.

From International conference on martensitic transformation; Boston, MA, USA (24 Jun 1979).

An analytical model of a martensitic transformation in an idealized body is constructed and used to carry out a computer simulation of the transformation in a pseudo-two-dimensional crystal. The reaction is assumed to proceed through the sequential transformation of elementary volumes (elementary martensitic particles, EMP) via the Bain strain. The elastic interaction between these volumes is computed and the transformation path chosen so as to minimize the total free energy. The model transformation shows interesting qualitative correspondencies with the known features of martensitic transformations in typical solids.

55201 Comments on the validity of steady-state dendrite growth models by R. J. Schaefer. Trivedi, R. (Technischen Univ., Braunschweig, Germany). *J. Cryst. Growth;* No. 44, 110-111(1978).

A brief discussion on the Schaefer analysis on dendrite growth is presented. It is shown that the Schaefer model deals with the representation of an infinite dendrite by a finite solid which is truncated near the sidebranch region. Such a model, therefore, does not correctly treat the effect of sidebranches on dendrite growth.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 54644, 54645, 54647, 54651, 54655, 54656, 54657, 54658, 54660, 54674, 54709, 54710, 54721, 54722, 54723, 54725, 54759, 54761, 54762, 54763, 54764, 54768, 54769, 54773, 54774, 54780, 54789, 54797, 54800, 54801, 54803, 54804, 54812, 54814, 54815, 54817, 54818, 54820, 54823, 54838, 54839, 54840, 54841, 54842, 54843, 54844, 54898, 54904, 54905, 55193, 55194, 55196, 55197, 55248, 55257, 55268, 55271, 55272, 55283, 55287, 55363, 55873, 55874, 55876, 55882, 55884, 55891, 55892, 55893, 55894, 55895

55202 (DOE/ET—0058/2, pp 85-99) **Microstructure of titanium scoping alloys prior to irradiation.** Davis, J.W.; Sastry, S.M.L.; Pionke, L.J. May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Studies to characterize the microstructures of the titanium scoping alloys before irradiation have begun. In general, the alpha-base alloys (Ti-6242S and Ti-5621S) are composed of a high percentage of primary alpha and transformed beta. The beta alloys, Ti-38-6-44 and Ti-15-3, are composed primarily of beta phase with alpha phase precipitates. The alpha-beta alloy Ti-6A1-4V has a variety of microstructures, but the primary phase is alpha.

55203 (DOE/ET—0058/2, pp 100-105) **Evaluation of niobium alloy data base.** Pionke, L.J.; Davis, J.W. May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

A large data base has been compiled on niobium alloys; however, the data base for any one alloy is limited. While a large amount of data exists on creep and creep rupture, most of the data are at higher temperatures and shorter times than those required for fusion devices. Data concerning the fatigue behavior at room and elevated temperature are meager, primarily because past applications were limited by creep and/or oxidation. No part of the existing data base shows that niobium-base alloys are deficient for fusion applications.

55204 (DOE/ET—0058/2, pp 118-131) **Effect of ^{4}He and ^{3}H on the tensile properties of SAP.** Maziasz, P.J.; Farrell, K. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Sintered Aluminum Product (SAP) has been doped with ^{6}Li and irradiated in HFIR to produce ^{4}He and ^{3}H at concentrations of 13, 270, and 1700 at. ppM and 2.0 to 6.7 dpa. The specimens were annealed at 300, 400, and 500°C for 1000 h after irradiation. Tensile testing (at the annealing temperatures) revealed little or no degradation in strength up to 1700 at. ppM ^{4}He and no loss of total elongation up to 270 at. ppM ^{4}He. Immersion density results show essentialy no swelling at any ^{4}He level.

55205 (DOE/ET—0058/3, pp 101-107) **Hydrogen permeation characteristics of path A, path B, and path C alloys.** Van Deventer, E.H.; Maroni, V.A. (Argonne National Lab., IL). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

The hydrogen dissolution and permeation characteristics of the 5621S alloy of titanium have been evaluated. This alloy was found to have a permeability of approximately 3000 times greater than that of conventional 300-series stainless steels. The observation of a pressure dependence some what greater than half-power was construed as evidence for a permeation process that is partially limited by surface impurity effects. Roughly determined values for the solubility of hydrogen in the 5621S alloy were in the range of those reported for Ti-6% Al-4% V. The surface condition and mechanical integrity of the 5621S membrane appeared to be unaffected by approximately 2000 h of hydrogen infiltration under typical power-reactor plasma-chamber conditions with respect to temperature, gas pressure, and gas composition.

55206 (DOE/ET—0058/4, pp 89-98) **Ductility in bending of molybdenum alloys irradiated between 425 and 1000°C.** Cox, B.L.; Wiffen, F.W. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

Samples of Mo, Mo-0.5% Ti, and TZM (Mo-0.5% Ti-0.09% Zr), initially fully recrystallized, were irradiated in the EBR-II to fluences of 2.5×10^{26} n/m^2 (> 0.1 MeV) in the range 425 to 1000°C. Rectangular coupons 3 x 2.8 x 0.4 mm were electropolished and then tested in vacuum in slow three-point bending from 22 to 650°C. The DBTT was bracketed by establishing the shift from failure in bending to full 45° bend under load.

55207 (DOE/ET—0065/6, pp 226-235) **Effects of irradiation on fusion reactor materials.** Nolfi, F.V. Jr. (Argonne National Lab., IL). Jul 1979.

In Damage analysis and fundamental studies.

Irradiations of Ni and Ni-4 at. % Si with 21 MeV deuterons at 2×10^{-6} dpa . s^{-1} to ~ 0.08 dpa showed greater radiation induced creep in Ni; hardening was observed only in the alloy.

55208 (FRNC-TH—748) **Fatigue-creep interaction. Effect of hold time on the fatigue strength of a Z2CND17-13 alloy (type 316L) at 600°C.** Brahim, R. (Paris-11 Univ., 91 - Orsay (France)). 1977. vp. (In French). Dep. NTIS (US Sales Only), PC A09/MF A01.

These (3e Cycle).

The fatigue-creep interaction is studied in the case of austenitic stainless steels used in the construction of fast neutron reactors. With a view to discuss the mechanical behavior of the materials, fatigue strength as a function of cycle number and strain hardening are investigated and semi-empirical equations for the evaluation of fatigue strength are developed. The results are interpreted in terms of microstructure and by application of the dislocation theory.

55209 (HEDL-TME—78-54) **Influence of heat treatment on the microstructure and mechanical properties of Alloy 718 base metal and weldments.** Mills, W.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1979. Contract EY-76-C-14-2170. 124p. Dep. NTIS, PC A06/MF A01.

Effect of heat treatment on the metallurgical structure and tensile properties of three heats of Alloy 718 base metal and an Alloy 718 GTA weldment were characterized. Heat treatments employed were the conventional (ASTM A637) precipitation treatment and a modified precipitation treatment designed to improve the toughness of the weldments. The GTA weldments were characterized in the as-welded condition. Light microscopy, thin foil, and surface replica electron microscopy revealed that the microstructure of this superalloy was sensitive to heat treatment and heat-to-heat variations. The modified aging treatment resulted in a larger grain size and a more homogeneous microstructure than the conventional treatments. The morphology of the primary strengthening γ phase was found to be finer and more closely spaced in the conventionally treated condition. Room and elevated temperature tensile testing revealed that the strength of the conventionally treated alloy was generally superior to that of the modified material. The conventional aging treatment resulted in greater heat-to-heat variations in tensile properties. This behavior was correlated with variations in the microstructure resulting from the precipitation heat treatments. The precipitate morphology of the GTA weldments was sensitive to heat treatment. The Laves phase was present in the interdendritic regions of both heat-treated welds. The modified aging treatment reduced the amount of Laves phase present in the weld zone. Room and elevated temperature tensile properties of the precipitation hardened weldments were relatively insensitive to heat treatment, suggesting that reduction in Laves phase from the weld zone had essentially no effect on tensile properties. As-welded GTA weldments exhibited lower strength levels and higher ductility values than heat-treated welds.

55210 (NBSIR—79-1609, pp 175-196) **Elastic-constant variability in stainless steel 304.** Ledbetter, H.M.; Frederick, N.V.; Austin, M.W. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Variability of elastic constants in stainless steel 304 was determined by measuring longitudinal and transverse ultrasonic velocities in twenty samples acquired randomly. Sample-to-sample variations, directional variation within a sample, and variations of repeated measurements on a single sample are reported for four elastic constants: the bulk modulus, Young's modulus, shear modulus, and Poisson's ratio. An inexpensive high-resolution measurement system was devised using general-purpose equipment augmented with a very simple impedance-transforming amplifier and a broadband detector.

55211 (NBSIR—79-1609, pp 313-351) **Metallurgical factors affecting the toughness of 316L SMA weldments at cryogenic temperatures.** Read, D.T. (National Bureau of Standards, Boulder, CO); McHenry, H.I.; Steinmeyer, P.A.; Thomas, R.D. Jr. Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The effects of delta ferrite content, ferrite morphology, carbon content, and sensitization on the fracture toughness and tensile properties of AWS/E316L and E316 shielded metal arc (SMA) weldments at 295, 76, and 4°K are reported. The SMA test welds were evaluated, eight made with E316L and two with E316 electrodes. All of the weldments had excellent toughness at room temperature. At 76°K, only the E316L weld with low ferrite had acceptable (to ASME Standards) toughness. Large decreases in toughness at 76°K and 4°K were related to increasing ferrite content. Decreases in Charpy impact energy at 76°K were also related to coarsened ferrite morphology caused by reduced cooling rates, to increased carbon content and to the sensitization heat treatment. The tensile-yield strength increased with ferrite content, especially at 4°K. Ferrite content generally effected the ultimate tensile strength or ductility only in a minor way.

55212 (NBSIR—79-1609, pp 353-400) **Microstructure of specific stainless steel weldments being evaluated for cryogenic service. Final report.** Elmer, J.W.; Steinmeyer, P.A.; Olson, D.L. (Colorado School of Mines, Golden). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Attempts to relate the microstructure of weld metals to their composition and mechanical behavior are reviewed. The Schaeffler constitution diagram for stainless steels, and the DeLong diagram are presented. The role of delta ferrite in explaining the behavior of weldments is discussed. The results of an experimental investigation to characterize the microstructure of a set of stainless steel weldments which had been extensively mechanically tested for cryogenic service are reported. Streicher and Huey corrosion test results are given.

55213 (NBSIR—79-1609, pp 455-505) **Structural alloys for superconducting magnets in fusion energy systems.** McHenry, H.I.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The behavior of selected alloys for superconducting magnet structures in fusion energy systems is reviewed with emphasis on austenitic stainless steels (AISI grades 304, 310S, and 316), nitrogen-strengthened austenitic stainless steels (304LN, 316LN, and 21Cr-6Ni-9Mn) and aluminum alloys (5083, 6061, and 2219). The mechanical and physical properties of the selected alloys at 4°K are reviewed. Welding, properties of weldments, and other fabrication considerations are briefly discussed. The available information suggests that several commercial alloys have adequate properties at 4°K and sufficient fabrication characteristics for the large magnet structures needed for fusion energy systems.

55214 (ORNL—5553) **Mechanical behavior of type 316 stainless steel heat 8092297 25-mm plate at 593°C.** Swindeman, R.W. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 76p. AT.

Tensile, creep, relaxation, and strain-cycling tests were performed on the reference heat of type 316 stainless steel. The purpose was to produce a data package that could aid in the development and verification of the high-temperature inelastic analysis methods for components fabricated from type 316 stainless steel. About 60 specimens were tested, mostly at 593°C. Tensile tests were performed in the strain rate range 1×10^{-8} to 0.27/s. The 0.2% yield stress was relatively independent of strain rate at 593°C, and a dynamic strain aging peak in the ultimate strength was indicated around a strain rate near 10^{-3}/s. The true-stress true-strain behavior was examined in terms of the Voce equation.

55215 (ORNL—5565) **Analysis of creep-rupture data for reference heat of Type 304 stainless steel (25-mm plate).** Swindeman, R.W. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 66p. AT.

Creep-rupture data are presented for a reference heat (heat 9T2796) of Type 304 stainless steel. Temperatures range from 482 to 871°C (900 to 1600°F), and times range from 0.0036 to 50 Ms (1 to 15,000 h). The data include rupture life, tertiary creep, true rupture strain, and true tertiary creep strain. Correlations are developed for rupture life vs engineering stress, modulus-compensated true stress, and modulus-compensated effective stress. The temperature dependence of the correlations is also examined. The tertiary creep is correlated with the rupture life. The rupture strain is correlated with both the modulus-compensated true stress and the modulus-compensated effective stress. Finally, the true tertiary creep strain is correlated with the rupture strain.

55216 (RDT-M—1-1T(8-79)) **Stainless steel covered welding electrodes (ASME SFA-5.4 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 8p. RSO.

This standard covers chromium and chromium-nickel stainless steel covered welding electrodes for nuclear and associated applications.

55217 (RDT-M—2-15T(7-79)) **Nickel-chromium alloy bars, forgings, and forging stock (ASME SA-637 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 10p. RSO.

This standard covers precipitation hardening nickel-chromium alloy bolting material (bars, forgings, and forging stock) for nuclear and associated applications.

55218 (RDT-M—6-5T(7-79)) **Alloy steel bolting material for special applications (ASME SA-540 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jul 1979. Contract W-7405-ENG-26. 11p. RSO.

This standard covers alloy steel bolting material for special applications in nuclear and associated service environments.

55219 (RDT-M—7-1T(8-79)) **Martensitic stainless steel (Type 403) bars (ASTM A 276 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 12p. RSO.

This standard covers martensitic stainless steel (Type 403 modified) bars for nuclear and associated applications. Material shall conform to the applicable requirements of ASTM A 276 as modified by Code Case 1337; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME), Section III, Article NB-2000; and to the additional requirements of this standard.

55220 (RDT-M—5-4T(8-79)(Rev.)) **Nickel-chromium-iron alloy plate, sheet, and strip (ASME SB-168 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-36. 11p. RSO.

This standard covers nickel-chromium-iron alloy plate, sheet, and strip for nuclear and associated applications. Material shall conform to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

55221 (RDT-M—5-7T(9-79)(Rev.)) **Nickel-iron-chromium alloy plate, sheet, and strip (ASME SB-409 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 11p. RSO.

This standard covers nickel-iron-chromium alloy plate, sheet, and strip for nuclear and associated applications. Material shall conform to the requirements of ASME SB-409; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

55222 (RDT-M—5-8T(8-79)(Rev.)) **Nickel-molybdenum-chromium alloy sheet and plate (ASME SB-434 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 10p. RSO.

This standard covers nickel-molybdenum-chromium alloy sheet and plate for nuclear and associated applications. Material shall conform to the applicable requirements of ASME SB-434 as modified by Code Case 1345; to the applicable requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

55223 **Constitutive relations based on state variables for nonelastic deformation in Type 304 and 316 stainless steels.** Huang, F.H. (Cornell Univ., Ithaca, NY); Yamada, H.; Li, C.Y. pp 83-94 of Characterization of materials for service at elevated temperatures. Smith, G.V. (ed.). New York, NY; American Society of Mechanical Engineers (1978).

Recent work on the development of constitutive equations, based on a state variable approach for nonelastic deformation in Type 304 and Type 316 stainless steels is reviewed and discussed. It is shown that this approach can be used in mechanical testing and in data correlation and extrapolation. New experimental data on grain-boundary sliding are presented and a constitutive equation is proposed for grain-boundary deformation processes based on these data.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 54413, 55199, 55200, 55203, 55213, 55246, 55280, 55281, 55283, 55301, 55364, 55653, 55767, 55891

55224 (BNL—26450) **Effects of alloying on the strain response of critical currents in Nb_3Sn conductors.** Luhman, T.; Kaiho, K.; Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 18p. (CONF-790815—8). Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

The critical current, I/sub c/, of bronze-processed Nb_3Sn conductors vary when the conductors are mechanically strained in tension or compression. The variations in I/sub c/ are reversible until the strains are large enough to cause cracking of the Nb_3Sn compound. After cracking occurs the changes in I/sub c/ with strain are irreversible. The reversible and irreversible characteristics of I/sub c/ are influenced by alloy additions to the conductors. Alloy additions to both the bronze matrix and the filament core are examined from the standpoint of their effects on the reversible and irreversible changes. Interpretation is based on our present understanding of the micromechanical aspects of these composite materials.

55225 (GEFR-SP—164) **Method of assessing the impact of metallurgical noise and its reduction in ultrasonic testing of austenitic welds.** Day, R.A. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Aug 1979. Contract EY-76-C-03-0893. 23p. (CONF-790868—1). Dep. NTIS, PC A02/MF A01.

From IEEE ultrasonics symposium; New Orleans, LA, USA (Aug 1979).

A method of reducing the ultrasonic noise, or spurious echos, often present in austenitic metals has been developed. The method has been used on specimens of Type 316 stainless steel, Alloy 800, 16-8-2 weld metal, and Inco-82 type weld metal. The method has been applied to shear wave tests and is applicable to longitudinal wave tests. Noise in these materials has been subsequently reduced relative to saw cut notches in welded samples. Signal-to-noise improvements of 8Db have been achieved in 16-8-2 weld metal, and order of magnitude improvement is obtained in the probability of large noise signals per inspection. Experiments with 1 and 1/2 megahertz inspection indicate that the improvement attributed to longitudinal wave inspection may be due to the difference in wavelength rather than wave mode.

55226 (INIS-mf—4905, pp 162-171) **Field-emission microscopy and emission characteristics of uranium. Film system.** Suvorov, A.L. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Emission characteristics of a tantalum-uranium metal film system produced in the diffusion of a readily fusible component (uranium) from the bulk of the refractory matrix have been studied using a field-emission microscope. Relative work function values corresponding to certain crystal faces have been determined. The obtained results are compared with the calculations by semi-empirical relations. The most promising directions are indicated for field-emission and field-ion microscopic investigations by using the method of analysis of film systems and dispersion inclusions of uranium.

55227 (IS-M—188) **Polarized neutron studies of the field induced magnetization in paramagnetic metals and their interpretation.** Stassis, C. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 32p. (CONF-790930—1). Dep. NTIS, PC A03/MF A01.

From Conference on polarized neutron in condensed matter research; Zaborow, Poland (10 Sep 1979).

The theory of the magnetic scattering of neutrons in metals and its application to the interpretation of the measurements of the induced moment form factors of paramagnetic solids are reviewed. Because of space limitations we restrict our discussion of the experimental results to three areas: field induced form factors of rare-earth metals, transition metals, and mixed valence systems.

55228 (Juel—1530) **Investigation of the laser-induced thermal desorption.** Hartwig, H.; Mioduszewski, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Aug 1978. 43p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

The physical and preasuring principles are given for experiments in the laser-induced thermal desorption from metal surfaces. The heating of the surfaces was studied with the CO_2 laser as well as with the ruby laser. An essential difficulty in heating metal surfaces by laser radiation is the intensity variation across the beam cross-section and the associated inhomogeneities at illuminating the surface. Therefrom will result temperature variations in the illuminated surface which, in the cases studied, correspond to a factor of 2. In addition to these variations of intensity there may occur - especially on technical surfaces - variations of radiation absorption, leading to temperature variations, too. The investigations have shown that the instantaneous increase in density in front of the sample, caused by desorbed gases, could be detected. In order to obtain reproducible results and to apply laser desorption as a reliable diagnostic method there must be improved, above all, the heat-up of the surface in such a way that reproducible and, if possible, homogeneous temperature distributions are achieved in the surface. This problem may be regarded as solved for the ruby laser, laser desorption with ruby lasers thus being appropriate for the 'in situ' examination of deposition on the first wall of a tokamak, (orig./HPOE).

55229 **Fascinating world of rare-earth research.** Gschneidner, K.A. (Ames Lab., IA (USA)). pp 1-10 of Rare earths and actinides, 1977. Corner, W.D.; Tanner, B.K. (eds.). Bristol; Institute of Physics (1978).

From International conference on rare earths and actinides; Durham, UK (4 Jul 1977).

The major events which occurred in the field of rare-earth research in the two decades 1950 - 70 are reviewed. Notable changes and advances in the field since 1971 are described with especial reference to; changes in research emphasis, the classification and systematization of the magnetic behaviour of rare-earth intermetallic compounds, the effect of impurities on the measured properties of the rare-earth metals, and unique inorganic structures. Actinide developments since 1971 are briefly considered.

55230 (LA—7903-PR, pp 63-65) **μSR study of diffusion in metals in the presence of paramagnetic ions.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

The μ^+ depolarization rate in Al—Gd (50 ppM) in a magnetic field of 80 Oe is shown from 10 to 560 K. Maximum value was about 0.7. For a 1-ppM sample the value remained approximately 0.05. The data seem to indicate cluster formation, or growth, with increasing temperature. 1 figure, 1 table. (RWR)

55231 (NBSIR—79-1609, pp 197-202) **Low temperature specific heat of two stainless steels.** Ho, J.C.; King, G.B.; Fickett, F.R. Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Specific heat values between 2 and 20°K are reported for the two stainless steels AISI 304 and AISI 304L. Measurements were made by standard adiabatic calorimetry. The results suggest that the thermal properties are comparable to AISI 310S, but the absence of magnetic clusters implies that these materials are more appropriate in low temperature applications where magnetic properties are critical.

55232 (NBSIR—79-1609, pp 203-280) **Magnetic susceptibility and magnetization studies of some commercial austenitic stainless steels.** Collings, E.W. (Battelle Columbus Labs., OH). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Results of magnetic susceptibility measurements using the Curie magnetic force technique are reported for six AISI 300-series alloys 310S, 304, 304L, 304N, 316, 316L as well as AWS 330 weld metal and Inconel 625. The temperature ranged from 5 to 416°K. Magnetization measurements over the temperature range 3 to 297°K, performed using a vibrating-sample magnetometer, are also reported. Alloy compositions and sample preparation procedures are discussed and numerical results of the study are presented. Magnetic characteristics of the four principal types of austenitic stainless steels studied are summarized.

55233 (NBSIR—79-1609, pp 281-293) **Some magnetic properties of the nonmagnetic stainless steels.** Fickett, F.R. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The magnetic properties of the austenitic stainless steels are discussed. Problems with using the permeability as a design parameter at low temperatures are outlined. Data are presented for very low field susceptibility and remanent magnetization of a large number of stainless steels measured at room temperature and at 4°K with a SQUID Magnetometer System.

55234 (SAN—0034-233-T1) **Effect of particle coupling on local electronic properties of superconducting small particles.** Ward, R.C. (California Univ., Riverside (USA)). Jun 1978. Contract EY-76-S-03-0034-233. 108p. Dep. NTIS, PC A08/MF A01.

Thesis.

The possibility of Josephson tunneling between superconducting small particles is examined. The Josephson coupling between the particles, which results from tunneling of Cooper pairs, is inserted into a modified Ginzburg-Landau free energy. The local electronic properties, the effective gap Δ and the order parameter relaxation rate Γ, are calculated in the Hartree approximation of this coupling free energy. A general expression, valid for any number N of particles coupled in a closed chain, was derived for the effective gap. A method for deriving the spectrum of the order parameter correlation function for any N was developed and analytical expressions were obtained up to $N = 8$. The order parameter relaxation rate was determined as the halfwidth at half maximum of this spectrum.

55235 (SAN—0034-T4) **Local electronic properties of dilute magnetic alloys.** Yoksan, S. (California Univ., Riverside (USA)). Dec 1978. Contract EY-76-S-03-0034-258. 115p. Dep. NTIS, PC A06/MF A01.

Thesis.

Some local properties of dilute magnetic alloys are studied in the normal and the superconducting states. The effects of elastic and inelastic scattering are considered. It is found that near the transition temperature, the spatial variation of the superconducting order parameter around a single magnetic impurity at large distances has a chracteristic 1/r dependence with an amplitude proportional to the depression of T/sub c/, whereas at short distances, the spatial dependence is of the form (a + bcos2k/sub f/r)/r^2 + c/r. A microscopic calculation is presented for the host nuclear spin-lattice relaxation time in the presence of 3d-transition metal impurities in a host at T << T/sub k/, as a function of impurity-host distance r. Two important mechanisms are considered; the relaxation due to the localized spin fluctuations, and the kinematic change because of the resonant scattering of conduction electrons. It is found that, for systems with low T/sub k/ such as Cu Fe, the spin fluctuation contribution is dominant and the Korringa relation is valid, but for systems with high T/sub k/, both mechanisms are of equal importance, the net host relaxation rate and the excess Knight shift do not satisfy the Korringa relation.

55236 **Scandium puzzle. What are its intrinsic properties.** Gschneidner, K.A.; Tsang, T.-W.E.; Queen, J.; Legvold, S.; Schmidt, F.A. (Ames Lab., IA (USA)). pp 23-27 of Rare earths and actinides, 1977. Corner, W.D.; Tanner, B.K. (eds.). Bristol; Institute of Physics (1978).

From International conference on rare earths and actinides; Durham, UK (4 Jul 1977).

The heat capacities of three different electrotransport-refined Sc samples have been measured from 1 to 20 K. The resultant electronic specific heat constant (γ) and Debye temperature (thetasubD) values are (10.337+-0.015) mJ/g. K^{-2} and (346.7+-0.8) K respectively. The influence of Mg, Fe and Zr impurities on the heat capacity have been studied. In the case of Fe a variety of results can be obtained by changing the Fe concentration and heat treatment; both a pure Kondo and a spin-glass system appear to exist in these alloys. The effects of electron concentration changes (Mg lowers it and Zr increases it) are consistent with the theoretical band structures and appear to explain the variation of γ with Mg or Zr additions. The change in thetasub(D) with these two alloying agents is anomalous and has not yet been explained. The results of electrical resistivity measurements on electrotransport-refined Sc single crystals are also presented.

55237 **X-ray photoemission investigation of the density of states of β'-NiAl.** Kowalczyk, S.P.; Apai, G.; Kaindl, G.; McFrely, F.R.; Ley, L.; Shirley, D.A. (Univ. of California, Berkeley). *Solid State Commun.;* **25**: No. 11, 847-851(1978).

The electronic structure of β'-NiAl was studied by x-ray photoemission spectroscopy (XPS). The observed valence band density of states agrees quite well with the non-relativistic APW calculations of Connolly and Johnson. These results are also compared with other experimental data. The hypothesis of d-band filling is supported by our XPS measurements.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 54035, 54208, 54399, 54409, 54410, 54411, 54412, 54413, 54415

55238 (COO—4993-1) **Investigation of dispersed iron alloy catalysts in the carbon-monoxide-hydrogen synthesis reaction. Progress report, August 1, 1978-July 31, 1979.** Butt, J.B.; Schwartz, L.H. (Northwestern Univ., Evanston, IL (USA)). Mar 1979. Contract ER-78-S-02-4993. 15p. Dep. NTIS, PC A02/MF A01.

Research on the characterization of the oxidation-reduction and carburization behavior of the Fe-Ni system using Fe/SiO_2, 4Fe-Ni/SiO_2, and Ni/SiO_2 catalysts is reported. (FS)

55239 (DOE/ET—0058/2, pp 148-157) **Capsule tests of iron-base alloys in lithium.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Data are reported on the compatibility between type 316 stainless steel and liquid lithium that contained either O, C, H, Al, Ti, Zr, Si, or Pb additions. The comparative corrosion resistance of a variety of 300 series stainless steels was also determined in purified lithium. Types 310 and 321 stainless steel exhibited the largest and smallest weight losses and surface degradations, respectively.

55240 (DOE/ET—0058/2, pp 158-164) **Thermal-convection loop tests of stainless steel in lithium.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Corrosion results are reported for two types of thermal-convection loops that circulate liquid lithium. A type 316 stainlss steel loop yielded weight change results similar to those from types 304L and 321 stainless steel loops, all of which operated for 3000 h at a maximum temperature of 600°C. Weight losses of type 316 stainless steel at 600°C were measured between 500 and 5000 h, and the rate of loss decreased with time. The operating status of the loops and future test plans are discussed.

55241 (DOE/ET—0058/2, pp 165-168) **Compatibility of blanket, coolant, and tritium-processing salts.** Keiser, J.R.; Upton, H.D. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Controlled amounts of HTS salt (KNO_3-$NaNO_2$-$NaNO_3$, 44-49-7 mol %) were reacted with lithium. A rapid, highly exothermic reaction occurred spontaneously on heating a mixture of the lithium and salt to about 180°C.

55242 (DOE/ET—0058/3, pp 84-91) **Capsule tests of type 316 stainless steel in nitrogen-contaminated lithium.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Approximately 2 wt % N in lithium significantly enhanced the degradation of type 316 stainless steel, with the corrosion rate decreasing as a function of time. At 500°C, the corrosion was uniform, while at 600 and 700°C, grain boundary attack dominated. As-rolled type 316L stainless steel had worse corrosion resistance to nitrogen-contaminated lithium than fully annealed type 316. We do not know whether the decreased resistance is attributable to differences in microstructure or alloy composition. While the corrosion of type 316 stainless steel in Li-2% N is more severe than in relatively pure lithium, such effects are expected to be transient in a closed system.

55243 (DOE/ET—0058/3, pp 92-98) **Thermal-convection loop tests of stainless steel in lithium.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Type 316 stainless steel thermal convection loops containing molten lithium are being used to investigate the effect of time on corrosion rates in lithium. corrosion rates are initially time dependent, decreasing up to 2000 h, and constant after approximately 200 h. Absolute weight losses among three loops were quite reproducible at short exposures (500 h) but diverged at longer times.

55244 (DOE/ET—0058/4, pp 114-119) **Capsule tests of Types 316 and 316L stainless steel in nitrogen-contaminated lithium.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

The weight loss and surface attack of as-rolled and fully annealed Type 316L stainless steel exposed to Li-2 wt % N differ little from previous data for fully annealed Type 316 stainless steel. At 700°C, the as-rolled Type 316L lost significantly more weight than similarly tested coupons of fully annealed Type 316L stainless steel. Additionally, the time dependence of grain boundary penetration of Type 316 stainless steel exposed to nitrogen-contaminated lithium at 600 and 700°C is related to the decreasing nitrogen concentration during testing.

55245 (DOE/ET—0058/4, pp 120-127) **Thermal-convection loop tests of stainless steel in lithium.** Tortorelli, P.F.; DeVan, J.H. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

Weight loss data for a Type 316 stainless steel loop that circulated lithium with 500 wt ppM N showed no major difference from a similar loop with purer lithium when differences in flow velocity were taken into account. Further data on weight loss versus exposure time to flowing lithium are reported. Steady-state corrosion rates generally range from 7 to 21 mg/m² h between 540 and 600°C. A simplified analysis of the steady-state corrosion rate as a function of temperature indicates that the corrosion process is controlled by liquid-phase diffusion.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 54197, 54690, 54813, 55207, 55311, 55756, 55766, 55871, 55874, 55875, 55896, 55899

55246 (CONF-790657—5) **Ion bombardment-induced changes in the surface composition of binary alloys.** Lam, N.Q.; Wiedersich, H.; Okamoto, P.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From Conference on irradiation behavior of metallic materials for fast reactor core components; Corsica, France (5 Jun 1979).

Redistribution of alloy components during heavy-ion bombardment was investigated using a kinetic model that includes the effects of radiation-induced segregation and preferential sputtering. Theoretical predictions are qualitatively compared with recent experimental measurements.

55247 (DOE/ET—0058/2, pp 62-84) **Response of Inconel 600 to simulated fusion reactor irradiation.** Wiffen, F.W. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Swelling, postirradiation tensile properties, and fracture behavior of Inconel 600 irradiated in HFIR to 4 to 9 dpa and 600 to 1800 at. ppM He are reported. The results suggest that this solid solution nickel base alloy does not offer any advantage over type 316 stainless steel.

55248 (DOE/ET—0058/2, pp 106-117) **Irradiation induced stress relaxation in titanium alloys.** Nygren, R.E. (Hanford Engineering Development Lab., Richland, WA). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Neutron irradiation creep rates were determined by stress relaxation measurements of four titanium alloys, Ti-6A1-4V (in three heat-treat conditions), Ti-6242S, Ti-5621S, and Ti-15-333. The super-alpha alloy Ti-5621S had the greatest creep strength and the beta alloy Ti-15-333 was weakest. The calculated irradiation creep coefficients ranged from 7 to 51 x 10^{-30} (psi-n/cm²)$^{-1}$ or 1 to 7 x 10^{-27} (MPa-n/cm²)$^{-1}$. The data were obtained with bent beam specimens irradiated in EBR-II (Row 7) to a fluence of 0.34 x 10^{22} n/cm² (> 0.1 MeV) at about 450°C (840°F).

55249 (DOE/ET—0058/3, pp 5-15) **Assessment of cyclic creep-fatigue of first-wall structural material.** Liu, K.C.; Brinkman, C.R.; Grossbeck, M.L. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Application of strain range partitioning showed that use of appropriate tensile and creep-rupture ductilities enables reasonably good estimates of the influence of hold periods and irradiation on the fully reversed fatigue life of type 316 stainless steel. Ductility values for 20%-cold-worked type 316 stainless steel irradiated in a mixed-spectrum reactor were used to estimate fusion reactor first-wall lifetimes at neutron wall loadings from 2 to 5 MW/m². Conjectural results indicate a lifetime of 7.5 to 8.5 MWyr/m² for loadings not exceeding 2 MW/m²; perhaps 10 MWyr/m² is posible since the wall will be under vacuum and the data base is for tests in air.

55250 (DOE/ET—0058/3, pp 16-19) **Sensitivity of the first wall radiation damage to fusion reactor blanket composition.** Barnes, J.M.; Santoro, R.T.; Gabriel, T.A. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

The atomic displacement and hydrogen and helium gas production rates in a 10-mm-thick type 316 stainless steel first wall have been calculated as a function of blanket composition in a typical one-dimensional fusion reactor model. For a 0.5-m-thick blanket, variations in the rates of atomic displacement and hydrogen and helium gas production of factors of 2.7, 1.3, and 1.2, respectively, were obtained. The damage also showed a systematic decrease with increasing first-wall thickness.

55251 (DOE/ET—0058/3, pp 20-23) **Design of materials irradiation experiments utilizing spectral tailoring.** Gabriel, T.A.; Thomas, W.E.; Zulliger, A.F.; Woods, J.W.; Bloom, E.E. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

The helium production to displacement per atom (He/dpa) ratio expected near or at the first wall of a fusion reactor for stainless steels and nickel-base alloys can be reasonably reproduced in real time in fission reactors as a result of the reactions $^{58}Ni(n,\gamma)^{59}Ni(n,\alpha)^{56}Fe$. The He/dpa ratio can be reproduced by intermittent modification of the thermal-to-fast neutron flux ratio since the He production will be dominated by the thermal flux and the fast flux will determine the dpa. This report summarizes neutronic calculations and experimental design considerations to determine: (1) the needed change in the thermal-to-fast ratio as a function of time, (2) the possibility of using the EBR-II in conjunction with the ORR, and (3) the configuration of the first experimental capsule.

55252 (DOE/ET—0058/3, pp 26-31) **Effect of 200 at. ppM preinjected helium on 20%-cold-worked type 316 stainless steel irradiated at 625°C in EBR-II.** Maziasz, P.J . (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Type 316 stainless steel cold-worked 20% has been preinjected with 200 at. ppM He and irradiated in EBR-II at 625°C to a neutron fluence of 1.6 x 10^{26} n/m² (> 0.1 MeV). The preinjected helium results in 1.2 x 10^{22} cavities/m³ that are 5 nm in diameter, while the uninjected material contains no cavities. The preinjected helium results in nearly an order of magnitude more cavities, and these cavities are slightly smaller than those produced by irradiation of the same material in HFIR. Preinjected helium appears to have no effect on the dislocation structure that develops during irradiation. However, all cavities produced by helium preinjection are attached to dislocations, as is observed after HFIR irradiaion.

55253 (DOE/ET—0058/3, pp 32-49) **Tensile properties of HFIR-irradiated types 316 and TiM 316 stainless steel at 200 to 1000 at. ppM He.** Grossbeck, M.L.; Maziasz, P.J. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Tensile tests were performed on type 316 stainless steel, with and without 0.23 wt% Ti added, irradiated in the HFIR to simulate fusion reactor first-wall conditions. Both annealed and 20%-cold-

worked materials were examined and hardened more rapidly than similar materials irradiated in EBR-II (containing only trace amounts of helium) but had comparable ductility for the fluences attained (2 x 10^{26} n/m^2, < 0.1 MeV).

55254 (DOE/ET—0058/3, pp 52-61) **Swelling of nimonic PE-16 irradiated in HFIR.** Wiffen, F.W. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Swelling-tensile samples of Nimonic PE-16 were irradiated in HFIR at 55 to 700°C to produce simultaneously dpa levels from 2.2 to 16.7 and helium contents from 120 to 2960 at. ppM. These conditions resulted in < 2% swelling. The maximum swelling, 1.92%, was found at 500°C in solution treated and aged material. The material solution treated only resisted swelling slightly more than aged material. Neither material showed very strong temperature dependence of swelling. There was no rapid, breakaway swelling above 600°C, as observed in type 316 stainless steel and alloy 600. The fluence dependence of the swelling suggests that an incubation period precedes significant swelling.

55255 (DOE/ET—0058/4, pp 24-39) **Tensile properties of HFIR-irradiated Types 316 and 316 + 0.23% Ti stainless steels.** Grossbeck, M.L.; Maziasz, P.J. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

Miniature tensile specimens of Types 316 and 316 + 0.23% Ti (TiM 316) stainless steel in the annealed and 20%-cold-worked conditions were irradiated in HFIR to displacement damage levels of 5 to 17 dpa and 200 to 1000 atm. ppM He. The specimens were tested near the irradiation temperatures. Reduction of area and true fracture stress were determined, and scanning electron microscope (SEM) fractographs were made to study the fracture mechanism and the effect of titanium on fracture. Type 316 stainless steel showed an unusual brittle behavior at 450°C. Associated with this behavior was a cavity structure visible on the fracture surface. The cavities are tentatively believed to be associated with helium.

55256 (DOE/ET—0058/4, pp 42-47) **Swelling of Nimonic PE-16 irradiated in HFIR.** Wiffen, F.W. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

Tensile-swelling samples of Nimonic PE-16 in the solution treated and aged condition were irradiated in HFIR at design temperatures between 300 and 700°C to fluences in the range 2.2 to 3.7 x 10^{26} n/m^2 (> 0.1 MeV). This fluence produced 17 to 28 dpa and helium contents of 3480 and 5700 at. ppM. The resulting swelling, determined by immersion density measurement, ranged from 0.27 to 2.9%. It increased monotonically with increasing irradiation temperature. The swelling data are not consistent with trends deduced from lower fluence irradiations, and detailed microscopy is planned to resolve the conflicting behavior.

55257 (DOE/ET—0058/4, pp 48-56) **Mechanical properties of Nimonic PE-16 following irradiation in HFIR.** Wiffen, F.W. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

Irradiation of solution treated and aged Nimonic PE-16 to produce 3 to 24 dpa and 180 to 4660 at. ppM He produced little or no change in the ultimate tensile strength of samples irradiated and tested near 55 or 500°C. In contrast, the yield stress was raised well above the control value by irradiation at either temperature. Samples irradiated at 55°C and then tested at higher temperatures showed a local minimum in strength change relative to control values and a local maximum in ductility at 600°C. At 600°C test temperature the failure mode was still transgranular. Tests at 650 or 700°C following the 55°C irradiation resulted in low elongation to failure. The fracture mode at 700°C was predominately intergranular separation. In samples irradiated and tested at 500°C the elongation remainted above 5% for irradiation producing up to 8 dpa and 1000 at. ppM He but dropped below 2% for 11.5 dpa and 1700 at. ppM He or greater.

55258 (DOE/ET—0058/4, pp 67-71) **Microstructure of Ti-6242S following low-fluence neutron irradiation at 400°C.** Sprague, J.A.; Smidt, F.A. Jr. (Naval Research Lab., Washington, DC). May 1979.

In Alloy development for irradiation performance.

The microstructure of Ti-6242S was studied by transmission electron microscopy (TEM) after irradiation in EBR-II to a fluence of 3.7 x 10^{21} neutrons/cm^2 (E > 0.1 MeV) at 400°C. The overall phase distribution in the alloy, equiaxed primary alpha with a small amount of transformed beta, was unaffected by this irradiation exposure. Electron diffraction patterns indicated the probable presence of the alpha-2, Ti_3 (Al,Sn) but it could not be determined if this phase precipitated during heat treatment or during irradiation. The principal irradiation-induced microstructural feature was a dense distribution of small dislocation loops in the primary alpha grains. The individual alpha plates in the transformed beta were very fine, as before irradiation, but they appeared to be somewhat irregularly shaped, possibly due to interference from the contrast of irradiation-induced lattice defects.

55259 (DOE/ET—0058/4, pp 72-84) **Comparison of titanium alloy Ti-6A1-4V and Ti-5621S microstructures after EBR-II irradiation.** Sastry, S.M.L.; O'Neal, J.E.; Davis, J.W. May 1979.

In Alloy development for irradiation performance.

Microstructural analysis was performed on two types of titanium alloys, the $\alpha + \beta$ alloy Ti-6Al-4V in the mill anneal and duplex anneal condition and the near alpha alloy Ti-5621S in the duplex anneal condition after neutron irradiation. The irradiations were made in Row VII of EBR-II to a fluence of 3.4 x 10^{21} n/cm^2 (E/sub n/ > 0.1 MeV) at 450°C. This fluence results in roughly 1.5 dpa. Analysis of the Ti-6Al-4V revealed that both conditions of Ti-6Al-4V contained a fine precipitate of what is believed to be beta phase and a high density of dislocation loops and debris. The precipitates are essentially ellipsoidal in shape and are roughly 100 to 200 Å in size. The precipitates appear to follow the Burgers relationships and were found to occur at low angle grain boundaries and along dislocations which were produced during the heat treatment. These precipitates appear to be unique to irradiated titanium and have not been observed as a result of long term thermal exposure. The Ti-5621S alloy showed no evidence of this precipitate. The primary defect structure of the Ti-5621S was extensive dislocation loops and c + a type of dislocations.

55260 (DOE/ET—0065/6, pp 21-26) **Helium generation in fusion reactor materials.** Kneff, D.W.; Farrar, H. IV. Jul 1979.

In Damage analysis and fundamental studies.

Preliminary helium analysis results are given for selected helium accumulation dosimetry samples irradiated in the MFE spectral characterization and MFE-1 experiments in the Oak Ridge Research Reactor.

55261 (DOE/ET—0065/6, pp 44-53) **Damage analysis and dosimetry radiation damage analysis.** Goland, A.N. (Brookhaven National Lab., Upton, NY). Jul 1979.

In Damage analysis and fundamental studies.

The displacement cross sections for both gamma rays and neutrons have been evaluated for Al_2O_3.

55262 (DOE/ET—0065/6, pp 57-66) **Radiation damage analysis and computer simulation.** Parkin, D.M. (Los Alamos Scientific Lab., NM). Jul 1979.

In Damage analysis and fundamental studies.

Calculations for Nb_3Sn show that the atom type that produces the majority of secondary displacements is a strong function of PKA type and energy.

55263 (DOE/ET—0065/6, pp 70-77) **14 MeV neutron irradiations (WZJ-14).** Guinan, M.; Barmore, W. (Univ. of California, Livermore). Jul 1979.

In Damage analysis and fundamental studies.

Fully dynamic computer simulations of defect production as a function of primary recoil energy in tungsten are in close agreement with experimental results for molybdenum. The decreased production efficiency for recoils above a few keV is the result of additional recombination occurring in the highly agitated lattice.

55264 (DOE/ET—0065/6, pp 93-103) **Phase stability under irradiation.** Russell, K.C. (Massachusetts Inst. of Tech., Cambridge). Jul 1979.

In Damage analysis and fundamental studies.

The stability of incoherent oxide dispersoids may be significantly altered by MFR first wall irradiation conditions; evaluation must be on a case by case basis.

55265 (DOE/ET—0065/6, pp 104-117) **Void swelling in irradiated metals.** Russell, K.C. (Massachusetts Inst. of Tech., Cambridge). Jul 1979.

In Damage analysis and fundamental studies.

Dislocations and interfaces are potential void nucleation sites only when not point defect sinks; in the presence of inert gas, they are excellent catalysts.

55266 (DOE/ET—0065/6, pp 118-139) **Irradiation response of materials.** Wood, S.; Spitznagel, J.A.; Choyke, W.J. (Westinghouse Research and Development Center, Pittsburgh, PA). Jul 1979.

In Damage analysis and fundamental studies.

By varying the helium implantation and atomic displacement rates independently, it is found that the instantaneous helium implantation rate is an important factor in cavity formation.

55267 (DOE/ET—0065/6, pp 144-184) **Radiation damage studies for fusion reactors.** Wilkes, P.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Jul 1979.

In Damage analysis and fundamental studies.

A new theoretical approach to radiation disordering is developed and applied to radiation-induced phase instability.

55268 (DOE/ET—0065/6, pp 185-191) **Mechanical properties.** Jones, R.H. (Battelle Pacific Northwest Labs., Richland, WA). Jul 1979.

In Damage analysis and fundamental studies.

Sixteen MeV protons induced 1.6 times more hardening in niobium than Be(d,n) neutrons in the first hardening stage while hardening rates were equal in the higher fluence stage. The hardening rate of T(d,n), Be(d,n) and 16 MeV proton irradiated nickel can be described by a single relationship as a function of fluence.

55269 (DOE/ET—0065/6, pp 192-208) **Simulating the CTR environment in the HVEM.** Jesser, W.A.; Johnson, R.A. (Univ. of Virginia, Charlottesville). Jul 1979.

In Damage analysis and fundamental studies.

The nature of crack propagation observed in in-situ HVEM tensile tests of 304 and 316 stainless steels can be correlated with the nature of the failure mode.

55270 (DOE/ET—0065/6, pp 217-225) **Mechanical properties.** Jones, R.H. (Battelle Pacific Northwest Labs., Richland, WA). Jul 1979.

In Damage analysis and fundamental studies.

Thin unirradiated 304 SS tubes have been cycled at 500°C at maximum tangenital stresses ranging from 224 MPa to 348 MPa. No indication of a leak was observed in 10^4 cycles at stresses below 286 MPa while at higher stresses the majority of failures were due to rupture.

55271 (INIS-mf—4903, pp 317-343) **Effect of radiation-induced defects on programmed strengthening of titanium.** Gindin, I.A.; Lapiashvili, Eh.S.; Leselidze, I.K.; Nartkoplishvili, C.S.; Naskidashvili, I.A.; Neklyudov, I.M.; Novozhilov, V.L. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Experimental data are given on the effect of titanium irradiation by neutrons (E approximately equal to 0.8 MeV) with integral doses up to $0.7+4x10^{18}$ n/cm² at different temperatures on the recovery of the yield limit and electric resistance under isochronous annealing of samples in the temperature range of -100 deg to 500 deg C. Proceeding from analysis of literary data on the recovery of titanium properties and the obtained results the mechanisms are described responsible for changes in structure and properties of the irradiated titanium under annealing in the free state and with a gradually varied load (programmed loading). The oriented redistribution of precipitate particles within titanium has been observed on annealig in the stressed state. It has been found that the greatest hardening of irradiated titanium takes place under programmed loading in the temperature range where stages of annealing the defects of irradiated titanium are pronounced.

55272 (INIS-mf—4903, pp 97-106) **Some theoretical problems of void formation.** Gol'tsev, V.P.; Korotov, V.F.; Fedyushin, E.E. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Some general features of a complicated dependence of swelling upon various factors are discussed for fcc metals. Existence of a well defined temperature range is considered when assuming its upper and lower limit as 1/3 and 2/3 of the absolute melting temperature of a material. Vacancy supersaturation is established at a high nucleation rate of point defects which should exceed some critical value. The latter is a function of a variety of factors specific to the material microstructure. A well defined radiation threshold dose is found at which the swelling is observed. Appreciable swelling occurs after considerable change in mechanical properties of a material under irradiation.

55273 (INIS-mf—4903, pp 273-316) **Peculiar features of structural transformations in high-nickel austenitic alloys and their influence on radiation damage.** Gorynin, I.V.; Ibragimov, Sh.Sh.; Kozhevnikov, O.A.; Parshin, A.M.; Yaroshevich, V.D. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Peculiarities of structural transformations in austenitic steels and alloys at different stages of solid solution decomposition are discussed and their influence on the radiation swelling and heat resistance is estimated. Special attention is paid to long-term rupture strength as a property determining the resistance to rupture caused by creep under operating conditions. The positive effect of the continuous homogeneous precipitation on physical and mechanical properties is shown. It has been found that certain alloying allows void formation and radiation swelling to be suppressed and the effect of neutron irradiation on the deformability and durability of high-nickel alloys to be considerably reduced.

55274 (INIS-mf—4903, pp 107-122) **Homogeneous helium implantation in fuel cladding materials for fast reactors.** Gruby, I.; Chervashek, I. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Procedure and apparatus are developed for helium homogeneous implantation in materials. For both annealed and deformed steels the plasticity decreases with an increase of helium content. The method developed foe helium homogeneous implantation enables a high temperature radiation embrittlement of materials for fast reactor fuel elements to be preliminarily estimated.

55275 (INIS-mf—4903, pp 89-96) **Void formation in nickel irradiated with nickel ions.** Lebedev, S.Ya.; Panin, S.D. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The formation of voids in nickel has been studied under the radiation conditions simulating the reactor ones. A commercially pure nickel has been annealed and then irradiated with helium ions for the concentrations ranging from 10^{-4} to 10 at%. The samples have been further irradiated with 49 keV nickel ions at a temperature of 500 deg C by integral doses from $2x10^{16}$ to $1.6x10^{17}$ ion/cm². It is shown that for one and the same radiation dose the void density increases and the void size-decreases as the helium concentration grows. Moreover, as the dose grows the increased swelling is observed. It is also found out that for one and the same dose the swelling of nickel, preliminary saturated with helium, is essentially lower than in the case of a helium-free material. Typical functions for swelling against helium concentration and the radiation dose, are shown as well as the normalized functions of a void-size distribution.

55276 (INIS-mf—4903, pp 63-88) **Kinetics of annealing radiation-induced voids and dislocations in the OKh18N9 and OKh18N9T stainless steels.** Pechenkin, V.A.; Shcherbak, V.I.; Konobeev, Yu.V. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The results of experimental and theoretical studies of annealing kinetics of radiation-induced voids and dislocations in the OKh18N9T and OKh18N9 stainless steels at 850 deg C are presented. Swelling, dislocation density, width of the void-free zone at grain boundaries have been measured at different stages of annealing. Experimentally obtained histograms of void size distribution are used as initial functions in the theoretical description of the void size distribution function during long-term annealing. The description of the behaviour of voids , dislocations and void-free zone at grain boundaries based on the proposed equations is given. It is shown that certain choice of the void size change rule, recombination cross-section of opposite-sign climbing dislocations and energy of self-diffusion in steel (3.Oev) allows theoretical and experimental functions of void size distribution, dislocation density and width of void-free zone at grain boundaries to be brought in agreement for all stages of long-term annealing.

55277 (INIS-mf—4903, pp 3-19) **Simulation studies of radiation swelling of nickel and its alloys. 1. Some problems of radiation swelling studies.** Zelenskii, V.F.; Neklyudov, I.M.; Matvienko, B.V. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Some technical problems of simulation studies of swelling using heavy ion accelerators are considered. Damage curves for target materials irradiated with high energy ions are calculated. Theoretical calculations are confirmed by the electron microscopy experiments using a step-by-step electrolytical thinning technique. The technique of thin film packet irradiation has been applied for the first time in investigations of void distributions with the ion penetration depth. The analytical equation is obtained for the calculation of swelling, the determination of sample thicknesses being excluded.

55278 (INIS-mf—4903, pp 20-43) **Simulation studies of radiation swelling of nickel and its alloys. 2. Study of swelling in nickel and its alloys.** Zelenskii, V.F.; Neklyudov, I.M.; Matvienko, B.V. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

In the paper some experimental results of swelling simulation of nickel and its alloys irradiated with Ni^+ (E=3MeV), Ar^+ and Xe^+ (E=2MeV) ions are considered. Temperature dependences of swelling have been obtained for different intercepts of a damage curve. A positive effect of scandium alloying on nickel resistance to radiation swelling is shown. Some possible mechanisms of the scandium effect on void nucleation and growth are considered. The effect of implanted argon on void formation in nickel is shown using the thin film technique.

55279 (INIS-mf—4905, pp 172-195) **Structural modification and phase changes in metals and alloys under irradiation: fundamental aspects.** Adda, Y.; Barbu, A.; Bocquet, J.L.; Martin, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1978.

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The results of a systematic study of radiation induced precipitation in NiSi undersaturated solid solutions by electron microscopy are reported. NiSi solid solution alloys containing 2,4,6 and 8 at % Si were irradiated with Ni+ ions (E=500 keV, I=$2x10^{-3}$ and $2x10^{-4}$ dpa/s, D=1 to 10 dpa) and electrons (E=1 MeV, I=$1.48x10^{-3}$ to $8.7x10^{-5}$ dpa/s, D=0.1 to 1 dpa). It was established the existence of dose rate thresholds for radiation induced precipitation. These thresholds are temperature dependent and also composition dependent. Second phase precipitation or resolution under irradiation may be viewed as one of the many mechanisms by which point defects recombine and agglomerate and which might in principle also account for the coupling between void growth and second phase precipitation. The capacity of various theoretical approaches to account for the observed solid solution decomposition is discussed.

55280 (INIS-mf—4905, pp 128-142) **Radiation defects and relaxation processes in refractory metals.** Bykov, V.N.; Zakharova, M.I.; Artemov, N.A. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Processes of interstitial redistribution during irradiation have been studied by the methods of measuring electrical resistivity, internal friction and density of monocrystalline vanadium, niobium, molybdenum and tungsten specimens irradiated to doses of $1.4x10^{22}$ and $1.14x10^{22}cm^{-2}$ at temperatures of 470 and 460 deg C, respectively. The orientation dependence of all studied properties is observed under irradiation. The parameters of internal friction as well as electrical resistivity decrease under irradiation, without any change in the orientation dependence profile. The radiation induced parameter variation of internal friction and electrical resistivity is due to migration of oxygen and other interstitials to radiation defects.

55281 (INIS-mf—4905, pp 336-352) **Nuclear gamma resonance study of defects in bcc metals under ion bombardment.** Bykov, V.N.; Zdorovtseva, G.G.; Troyan, V.A. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The nuclear gamma resonance method has been used to study electronic structure of the defects produced during implantation of accelerated helium and nitrogen ions into samples of iron and tungsten. Annealing characteristics have been obtained for the isomeric shift and Moessbauer effect probability. With the obtained data in mind, models of formation and annealing of crystal lattice defects are discussed.

55282 (INIS-mf—4905, pp 87-102) **Simulation of zirconium irradiation with high DPA doses.** Elesin, L.A.; Krasnoshtanov, V.F.; Stolyarova, G.S. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The method of the express defect accumulation in zirconium is discussed. Zirconium having the ZrB_2 phase inclusions was irradiated in the reactor channel. The damages were induced by He and Li ions produced in the reaction $^{10}B(n,\alpha)^7Li$ and reached the level $3x10^{-6}$ DPA/sec which is hundred times higher than the level of damages induced by neutron fluxes. The damage zones around the ZrB_2 precipitations were computed using the SPECTR programs. It was found that the regions of damages induced by α and Li tend to separate around small-size precipitations. The calculated concentration of He in the ZrB_2 zone is by two orders of magnitude higher than the critical value. The comparison between the calculated and experimental results is made.

55283 (INIS-mf—4905, pp 111-127) **Interaction of radiation-induced defects with initial structure defects in metals and radiation strain hardening.** Gindin, I.A.; Neklyudov, I.M.; Chirkina, L.A.; Okovit, V.S. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The effect of 225 MeV electron irradiation at 77 and 320 K on the physical and mechanical properties of metals of different defect structures and different stacking fault energy is studied experimentally at 300 K. Data are presented for the Fe-3 % Si, Cu, Ni and Al. By measuring electric resistance, microhardness, coercive force of the amplitude-dependent internal friction and mechanical properties under tension it was shown a considerable influence of density, type, configuration, depth distribution and splitting degree of dislocations on accumulation and redistribution of radiation-induced defects. Mechanism governing the processes pf microplastic deformation are suggested. It is concluded that irradiation strain hardening of metals and alloys increases with stacking fault energy.

55284 (INIS-mf—4905, pp 353-363) **Dynamic structural changes of second-phase precipitate under irradiation.** Ibragimov, Sh.Sh.; Kirsanov, V.V. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The work studies reconstructions of precipitated and pre-precipitated phases in metal alloys under irradiation. In particular, the result is given of the form changing of the second-phase precipitate under irradiation (the transition of lamellar cementite in pearlitic steel into equiaxial one). On the ground of the analysis of cascade interactions with pre--cipitations the notion of damaged volume of the precipitation is introduced, it is compared with the critical volume of precipitation reconstruction (change of the form, soluting, decrease of size). In the case when the critical volume of reconstruction is less than the damaged volume the precipitation is subjected to a dynamic reconstruction (i.e. the reconstruction due to the interaction with collision cascades). A mathe--matical model of kinetics of dynamic reconstructions is given. It is pointed out that defect clusters may also be subjected to such a reconstruction (e.g. a vacancy loop transition into void).

55285 (INIS-mf—4905, pp 3-32) **Mechanical properties and structure of refractory metal base alloys exposed to neutron irradiation.** Kazakov, V.A.; Pokrovskii, A.S.; Smirnov, A.V. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The effect of neutron irradiation on mechanical properties and the structure of the V-2.5, Zr-0.35C, Nb-I Zr-0.1C and Mo-0.11 Zr-0.002B alloys has been investigated at 730-1070 deg C and (1.3-1.8) 10^{2} n/cm^2 (> 0.1 MeV). It is shown that under these conditions the irradiation results in intense softening of the V-Zr-C alloy and hardening of the Nb-Zr-B and Mo-Zr-B alloys, whereas a minimum yield strength increase of two latter alloys is observed in the radiation temperature range 0.43-0.45 Tsub(m). Reasons for appreciable irradiation-induced enhancement of V-Zr-C softening are established. It is shown that the minimum softening of the Mo-Zr-B alloy at temperature of 0.43-0.45 Tsub(m) is due to suppressing void formation at these temperatures. Properties of vanadium, niobium and molybdenum alloys exposed to neutron irradiation are discussed.

55286 (INIS-mf—4905, pp 196-210) **Phase transformations under ion bombardment.** Khmelevskaya, V.S.; Bykov, V.N.; Zdorovtseva, G.G.; Troyan, V.A.; Miklin, L.S. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Ni, Fe, Mo, W, Ti, Al, Cu, Ag and Ge films 700 to 1000A thick were irradiated with 30 to 50 keV He^+, N^+ and Ar^+ ions up to integral doses of 10^{15} - 10^{18} ion/cm^2. Phase transformation and newly formed metastable structural phases in metals were studied using electron diffraction technique, electron microscopy and resistivity measurements. It is shown that under irradiation in transition metals metastable phases of interstitial type are formed. It is assumed that interstitials are matrix atoms displaced to interstitial sites in atom collisions and nucleation of new phases takes place through dislocation loops with stacking falts inside. In non-transition metals irradiated to above-mentioned doses no structural changes were observed.

55287 (INIS-mf—4905, pp 33-40) **Computer modelling of radiation hardening at an initial stage of reactor irradiation.** Kolomytkin, V.V.; Krasnoshtanov, V.F.; Platonov, P.A. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The dislocation motion in the area of the sweeping plane with zones of structure damages has been investigated to estimate the irradiation hardening at an initial stage of the reactor irradiation. For the random location of the zones presented as effective spherical voids a computer program was written. This helped to obtain the increments of the critical shear stress versus the annealing temperature of platinum samples. In the calculations of irradiation hardening we used the size concentrations and distributions of structure damage zones obtained from structure studies of irradiated platinum samples using a field-ion microscope. The results of the computer simulation of irradiation hardening show better agreement with the experimental data than the results of most trivial analytical calculations.

55288 (INIS-mf—4905, pp 69-86) **Computer modelling and experimental study of radiation-enhanced diffusion in nickel.** Zelenskii, V.F.; Gann, V.V.; Volobuev, A.V.; Reznichenko, E.A.; Sheredeko, A.P. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Accumulation of point defects in a nickel plate under irradiation by charged particles is calculated. Using numerical techniques nonsteady-state diffusion equations for vacancies and interstitials are solved. Depth profiles of defect distribution are obtained as a function of irradiation time. The radiation-enhanced diffusion is shown to result in expansion of damage range under ion irradiation. By means of absorption technique the effect of irradiation with 2.2 MeV hydrogen and helium ions on nickel selfdiffusion at 630 deg C was studied experimentally. The dependences of the radiation selfdiffusion coefficient D on the defect production rate K are obtained, which are described by expressions D approximately Ksup(0.6) -

under hydrogen ion irradiation, and D approximately Ksup(0.75) - under helium ion irradiation. Comparison of theory with experiments is carried out.

55289 (Juel—1541) **Influence of fast neutrons on the transport behaviour of solid fission products in pyrocarbon-coated nuclear fuel particles.** Foerthmann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Oct 1978. 62p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

The transport behaviour of metallic fission products in pyrocarbon-coated fuel particles is investigated by means of postirradiation annealing at 1400°C as a function of the fast neutron fluence. The release of Ba and Sr are both increased by fast neutrons, and that even, if the kernels contain alumina additives, which improve the fission product retention by forming aluminates (e.g. $BaAl_2O_4$). The release of these two fission products is controlled by the effective diffusion coefficient in the kernel, which is in the case of Sr-90 in the range of 5,7.(period on line)$10^{-18}cm^2s^{-1}$ (nonirradiated) and 5,3.(period on line)$10^{-13}cm^2s^{-1}$ (fluence 2.(period on line)$10^{22}cm^{-2}$ at E>0,1 MeV). The most significant increase is observed in the low fluence region. Ru and Ce are released from the kernels by recoil only, not by diffusion. The Cs release is controlled by diffusion in the outer coating layer and depends on the microstructure of the pyrocarbon: The diffusion coefficient is decreased by fast neutrons, if the amount of fiber component in the pyrocarbon is high. At low amounts of fiber component the diffusion coefficient is increased by fast neutrons.

55290 (KFK—2732) **Deposition of radionuclides on Mol-7B samples.** Stamm, H.H.; Clauss, H.; Hanke, H.D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Nov 1978. 20p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

34 coupons (made of four different types of stainless steel) were exposed to flowing sodium at 410°C and 210°C, respectively, for 383,9 days in an in-pile sodium loop of the research reactor BR2 (Mol, Belgium). About half the time the loop was operated with one or more fuel pin failures. The weight gain of the samples during sodium exposition was 1 to 2 mg/cm^2; it was hardly depending on the surface pretreatment of the coupons. Deposition of Sb-125 was higher on the cold-leg samples, than on the hot-leg coupons, while more activities of Mn-54, Co-60, Rh-106, Ce-144, Eu-154 and Eu-155 were measured on the hot-leg specimens. Most of Cs-137 and Cs-134 were removed from the coupons by water, residual activities on both kinds of samples were equal. Deposition of radionuclides were independend from the type of stainless steel, and independent from surface pretreatment.

55291 (WARD-AD—3045-12) **Grain boundary cavitation model for post-irradiation tensile ductility in Nimonic PE16. Part I: diffusion controlled model.** Chang, A.L.; Bleiberg, M.L. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jul 1979. Contract EY-76-C-02-3045-024. 23p. AT.

Based on the correlation between microstructures and mechanical properties, a diffusion controlled grain-boundary-cavitation-model was modified to account for the ductility-temperature trough observed in post-irradiation tensile tests of Nimonic PE16. Helium bubbles along grain boundaries were considered to be the nucleation sites for microcracks. The crack growth rate was found to be very sensitive to the interfacial half angle α, the smaller the α the larger the growth rate. It was also determined that the growth rate was proportional to (D/sub g/l^{-3}) where D/sub g/ is the grain boundary diffusivity of vacancies feeding the crack and l is the inter-crack half distance along grain boundaries. Using the observed stress-strain relations and microstructural data as input, the time-to-failure, t/sub f/, can be evaluated by numerical integration for various conditions. The apparent success of the model suggested that the down swing of the ductility-temperature trough in specimens irradiated below or equal to 625°C was due to the increasing vacancy diffusivity with increasing test temperatures, helping to shorten the time-to-failure (or ductility). The upswing of the ductility trough in specimens irradiated at 735°C and tested at 735°C was due to the greater interbubble distance induced by irradiation at higher temperatures. This investigation confirmed that although diffusion time was short in a typical tensile test, at T/sub t/ ≧ 560°C, the crack growth rate due to vacancy diffusion was sufficiently fast to cause crack linkage and failure within the time periods observed. 19 references.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 55008, 55398

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 54200, 54201

55292 (INIS-mf—4897) **Synthesis, sintering properties and thermal conductivity of uranium carbonitrides.** Wolters, R.A.M. (Technische Hogeschool Twente, Enschede (Netherlands)). 5 Oct 1978. 133p. Dep. NTIS (US Sales Only), PC A07/MF A01.

Proefschrift (Dr.).

An introduction to the applications and chemistry of uranium carbonitrides is given including the potential use as a nuclear fuel. The powder synthesis of UC, UN and mixtures of UC and UN by a cyclic process is described. The correlation between the composition ratio UN/(UC+UN) in the final product and the parameters of the process is only determined qualitatively. Batch synthesis of a powder does not lead to an increase of the content of metallic impurities and oxygen. The impurity level is determined by that of the starting uranium metal and the thermal conductivity of the sintered compacts of uranium carbonitrides are determined via the measurement of the thermal diffusivity at 1100-1700 K.

55293 (IS-T—869) **Single crystal LaB_6.** Noack, M.A. (Ames Lab., IA (USA)). Jul 1979. Contract W-7405-ENG-82. 90p. Dep. NTIS, PC A05/MF A01.

Thesis.

Single crystals of LaB_6 were prepared by float zone refining of hot pressed blocks of LaB_6. The orientations studied were (001), (110), and a high index plane. The resulting crystals and the as-received material were chemically analyzed by vacuum fusion, combustion analysis, self-arc mass spectroscopy, and wet chemical analysis. The first two provided accurate analysis for O, N, H, and C. The remaining elements except for La and B were determined by mass spectroscopy. The wet chemical analyses determined the B/La ratio. Two batches of as-received material had B/La ratios of 6.0 and 5.8, respectively. Slightly lower B/La ratios were obtained in the single crystals grown by the float zone technique from these materials. The single crystals were further characterized by measurements of lattice parameter and density. Work function values were determined by the FERP method and the thermionic method. Work function measurements in conjunction with Auger analysis of the crystals provided insight into the electron emission character of LaB_6. Results indicate that for maximum emission from a crystal plane a proper heat treatment is necessary. Brightness of the crystals was measured in a Cambridge S-4 scanning electron microscope using a Broers type gun. Results show that a brightness of 10^6 amp/cm^2 steradian (20kV) may be achieved with a single crystal LaB_6 cathode operating at a temperature of 1900°K which corresponds to a lifetime greater than 500 hrs for 1 mm cathodes.

55294 (SAND—79-0097C) **Chemical vapor deposition of silicon nitride. I. Oxygen contamination.** Wells, V.A.; Hanson, M.V. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-791017—4). Dep. NTIS, PC A02/MF A01.

From 7. international conference on chemical vapor deposition; Los Angeles, CA, USA (14 Oct 1979).

Silicon nitride films are important to the microelectronics industry for their use as diffusion and passivation barriers, as well as in the development of non-volatile memories. In this work, the effects of oxygen contamination on the chemical vapor deposition of silicon-nitride are reported. The changes in deposition rate, etch rate, and refractive index are measured. From this data suitable process conrols can be established.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 55293

55295 (BNL—26502) **Structural refinement of neutron and x-ray data by the Rietveld method: application to Al_2O_3 and $BiVO_4$.** Cox, D.E.; Moodenbaugh, A.R.; Sleight, A.W.; Chen, H.Y. (Brookhaven National Lab., Upton, NY (USA); Du Pont de Nemours (E.I.) and Co., Wilmington, DE (USA)). 1979. Contract EY-76-C-02-0016. 21p. (CONF-790637—2). Dep. NTIS, PC A02/MF A01.

From Symposium on accuracy in power diffraction; Washington, DC, USA (11 Jun 1979).

The application of the Rietveld refinement technique to neutron and x-ray powder data from standard samples of Al_2O_3 is described. The results are compared with those obtained by conventional refinements of the corresponding integrated intensities, and also with x-ray single crystal data. The Rietveld technique has also been used to analyze neutron and x-ray powder data in a structural study of $BiVO_4$. Since V has a very small neutron scattering amplitude, the x-ray data allow a more accurate determination of the V position to be made.

55296 (CEA-R—4905) **Study of the Na-C-O and Na-H-O ternary systems in the sodium rich corner.** Maupre, J.-P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides; Aix-Marseille-1 Univ., 13 - Marseille (France)). Feb 1978. 367p. (In French). Dep. NTIS (US Sales Only), PC A15/MF A01.

Thesis.

The purpose of this study is to provide a contribution to the understanding of the sodium - carbon - oxygen and sodium - hydrogen - oxygen ternary systems in the sodium rich corner. In order to do this the Na-NaH-Na_2O-NaOH phase diagram was completed and the Na-Na_2O-Na_2CO_3-C phase diagram was outlined. This work is made up of two parts. The first is devoted to a critical literature survey essential to establish correct phase diagrams. The second is an experimental study followed by a discussion collating our finding to the literary data. The basic experimental technique used is differential thermal analysis (DTA) but it has been completed by quenching, X-ray and chemical analysis methods. The proposed phase diagrams imply that Na-NaH-Na_2O-NaOH and Na-Na_2O-Na_2CO_3-C systems are reciprocal ternary systems. Temperatures of stable pairs reversal are respectively 410 and 690°C. The stable pairs are Na-NaOH and Na-Na_2CO_3 at elevated temperature, Na_2O-NaH and Na_2O-C at low temperature.

55297 (ORO—4837-6) **Electronic structure of defects in oxides. Progress report, December 1, 1978-November 30, 1979.** Summers, G.P. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). 1979. Contract EY-76-S-05-4837. 22p. Dep. NTIS, PC A02/MF A01.

Excitation into the 6.1 eV F band in single crystal samples of α-Al_2O_3 produces a luminescence with a peak at 3.0 eV and a half-width of 0.36 eV at 4.4°K. The temperature dependence of the half-width follows a hyperbolic cotangent relation with an effective frequency of 370 +- 20 cm^{-1}. At 4.4°K the fluorescence decay contains two components. One of these, which has a lifetime of 24 +- 2 ms, is assigned to a spin forbidden transition from the lowest lying component of the symmetry split ^{3}p-like excited state of the F center to the $^1A_1$ ground state. The other component has a lifetime of 272 + 10 ms at 4.4°K and is assigned to phosphorescence due to shallow electron traps in the lattice. At 50.4°K a single component is observed in the fluorescence decay, with a lifetime of 35 +- 2 ms. This fluorescence is assigned to a second spin forbidden transition of the F center. The excited states of the F^+ center in neutron or proton irradiated SrO have been studied by measuring the temperature dependence of the yield and lifetime of the F^+ fluorescence over the temperature range from 5°K to 140°K. Both the fluorescence yield and lifetime decrease in two stages; one over the temperature range from 5°K to 60°K, and the other over the range 60°K to 140°K. The results are interpreted in terms of a three level model of the F^+ center which is suggested by recent theoretical work. The lowest radiative level, which has a lifetime of 0.42 μs, is found to be 0.05 eV below the conduction band. Another level is found only 0.005 eV above this radiative level. In order to account for the results, non-radiative decay to the ground state appears to occur from this second level.

55298 **Direct observation of the polytype periodicities in the Be-Si-O-N system.** Clarke, D.R. (Univ. of California, Berkeley); Shaw, T.M.; Thompson, D.P. *J. Mater. Sci.;* **13**: 217-219(1978).

Direct lattice fringe observations of polytypism in the ceramic Be-Si-O-N system are presented. Polytypes of similar structure are also found in Mg-Si-Al-O-N and Li-Si-Al-O-N systems. (FS)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 54393, 55030, 55292, 55293, 55294, 55297, 55846

55299 (CONF-790538—17) **Temperature dependence of the Haven ratio in silver beta-alumina.** Kim, K.K.; Chandrashekhar, G.V.; Chen, W.K.; Mundy, J.N. (Argonne National Lab., IL (USA); IBM Watson Research Center, Yorktown Heights, NY (USA)). 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

Measurements of Ag diffusivity (D) and ionic conductivity (σ) have been made on the same single crystals of silver beta-alumina with composition 1.23 $Ag_2$0.11 Al_2O_3. The D values were obtained from the cation exchange rate of radiotracer ^{110}Ag in molten $AgNO_3$ over 210° C ~ 400°C. The σ measurements were made using an impedance bridge with sputtered silver electrodes at a frequency of 3 x 10^5 Hz over R.T ~ 450°C. Both D and σ can be expressed in a simple Arrhenius form as: D = 1.47 x 10^{-4}(cm^2/sec) exp [-4.05(Kcal/mol)/RT]; σT = 1.58 x 10^3($ohm^{-1}cm^{-1}K$) exp [-3.77(Kcal/mol)/RT]. The Haven ratio varies from 0.51 at 200°C to 0.56 at 400°C. The magnitude of these values is very close to the theoretical value of 0.6 for interstitialcy mechanism. The temperature dependence is strikingly similar to the case of sodium beta-alumina.

55300 (SAND—79-1715C) **Dielectric strength of SiO_2 in a CMOS transistor structure.** Soden, J.M. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-790936—1). Dep. NTIS, PC A02/MF A01.

From Electrical overstress/electrostatis discharge symposium; Denver, CO, USA (25 Sep 1979).

The distribution of experimental dielectric strengths of SiO_2 gate dielectric in a CMOS transistor structure is shown to be composed of a primary, statistically-normal distribution of high dielectric strength and a secondary distribution spread through the lower dielectric strength region. The dielectric strength was not significantly affected by high level (1 x 10^6 RADS (Si)) gamma radiation or high temperature (200°C) stress. The primary distribution breakdowns occurred at topographical edges, mainly at the gate/field oxide interface, and the secondary distribution breakdowns occurred at random locations in the central region of the gate.

55301 **Specific heat of $Y_{0.7}Th_{0.3}C_{1.88}$.** Stewart, G.R.; Giorgi, A.L.; Krupka, M.C. (Los Alamos Scientific Lab., NM). *Solid State Commun.;* **27**: No. 4, 413-416(1978).

The specific heat of the novel high temperature superconductor $Y_{0.7}Th_{0.3}C_{1.88}$ (T/sub c/ = 17.0 K) has been measured between 4 and 22°K. Unlike the other known high temperature superconductors (T/sub c/ > 16°K which have either an A-15 or a NaCl-type structure, this material forms in the bcc, Pu_2C_3-type, structure. The Debye temperature, theta/sub D, is 346°K and the linear term coefficient, γ, of the specific heat has the value 4.66 mJ/mole-K^2. Thus the electronic density of states, N(0), which is proportional to γ, is quite low. The energy gap, 2Δ/kT/sub c/, on the other hand has an anomalously high value of 5.8. Comparisons between these parameters of $Y_{0.7}Th_{0.3}C_{1.88}$ and those for some A-15 and NaCl-type superconductors are made.

55302 **Domain structures of sodium tungsten bronzes, Na/sub x/WO_3 (0.4 < x < 1).** Atoji, M. (Argonne National Lab., IL). *Solid State Commun.;* **27**: No. 11, 1227-1231(1978).

Optical-microscope observations with polarized light have shown that the birefringent, twin-domain structure of sodium tungsten bronzes is exhibited by Na-deficient, epitaxial surface films and hence is not a bulk property as had been suggested elsewhere. The film is translucent, 10^{-2} - 10^{-3} mm thick or less, and often laminates to a multi-film layer. The domain boundaries are sensitive to lateral stress and, apparently, to minute changes in the substrate structure. These and related properties of the film and the substrate are presented.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 54677, 55294

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 54197, 54198, 54199, 55282, 55297

55303 (INIS-mf—4905, pp 143-161) **Field-ion microscopy of fission fragment damage in thoriated tungsten.** Suvorov, A.L.; Kukavadze, G.M.; Bobkov, A.F. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Fission induced defects in the crystal lattice of the W-1.5% ThO_2 alloy were studied with a field-ion microscope. The fission fragments were produced in wire specimens irradiated with fast neutrons in the experimental channel of the ITEP heavy-water moderated reactor. The mean volume of the depleted zones wich result from the atomic displacement initiated by one primary knock-on atom (PKA) was found to be 350 tungsten atomic volumes for an average number of vacancies of 10. The mean PKA energy was estimated to be E approximately 1.25x10^3 eV. The directions of atomic displacements along (110) and (10O) were found to predominate by 4-6 times as compared to others. Overlapping of cascades led to the formation of depleted zones with linear dimensions of 30-100A and with vacancies up to 20%. A high concentration of impurities in the samples probably prevented from the removal of atoms from the depleted zones at large distances (>20A) due to the chains of focused collisions.

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

55304 (LA-UR—79-951) **Preparation of unidirectional fiber reinforced tantalum carbide composites.** Newkirk, L.R.; Riley, R.E.; Sheinberg, H.; Valencia, F.A.; Wallace, T.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-791017—5). Dep. NTIS, PC A02/MF A01.

From 7. international conference on chemical vapor deposition; Los Angeles, CA, USA (14 Oct 1979).

A process is described for uniformly infiltrating 3000 filament carbon yarn with Ta and subsequent densification by hot pressing. Ta deposition rate is characterized as a function of deposition

temperature, reactant flows, yarn pull rate, and coating chamber geometry for yarn pull rates from 2 to 50 m/h and Ta loadings from 40 to 350 wt % gain. Densification procedures for unidirectional pressings are described and data is presented which shows significant improvement in flexure strength over conventional TaC-C powder composites.

MECHANICAL PROPERTIES

55305 (NBSIR—79-1609, pp 403-451) **Nonmetallics for magnet systems.** Kasen, M.B.; Hust, J.G.; Ledbetter, H.M. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The results of cryogenic mechanical, thermal, elastic and electrical property characterization of G-10CR and G-11CR laminates manufactured in the pilot plant of one industrial laminating firm are summarized. Cooling to cryogenic temperatures is found to improve the mechanical properties of both laminates. Data on thermal contraction and volume electrical resistivities at cryogenic temperatures are presented. The thermal conductivity of these materials is reported for temperatures from 2 to 300°K. Measurements were conducted both normal to the glass fabric plane and in the fabric plane using the thermal conductivity integral method. Young's moduli were determined dynamically in the warp, fill, and normal directions between room temperature and liquid-nitrogen temperature.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

55306 (SAND—78-1866C) **Synthesis and characterization of new polyether based soluble polyurethanes.** Wagner, J.A.; Arnold, C. Jr. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-790917—3). Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

It was undertaken to develop a rmovable material which would have properties similar to crosslinked, insoluble encapsulants but allow rework capability. Applications require minimal creep at 80°C, tensile yield strength of ~ 14 Mpa (2000 psi), glass-transition temperature of ~ -70°C, percent elongation of ~ 400%, volume resistivity > 10^{10} ohm-cm, and a shear modulus of 14-27 Mpa (2000-4000 psi) which does not decrease significantly in the temperature range 20-120°C. A series of polyether-based soluble polyurethanes has been synthesized and a number of mechanical and electrical properties have been measured. The polyurethanes were forumulated using bitolylene diisocyanate (TODI), polytetramethylene ether glycol (several molecular weights were tried) and two different diols. A number of forumulations were tried and efforts concentrated on the two most promising materials. Since it was determined that the cure was not complete after the standard length of time (16 hours, verified by an isocyanate absorption in the infrared scan at 2280 cm^{-1}), a post cure of sixteen hours was carried out. Average test results on the two best formulations were: (1) shear modulus 30-35 Mpa, (2) glass transition temperature -70°C, (3) 400 percent elongation, (4) tensile strength 14 Mpa, (5) volume resistivity 10^{13} ohm-cm, and (6) solubility in tetrahydrofuran. The post cure did not significantly improve any of the properties of the material.

55307 (UCRL—82488) **Environmentally enhanced crazing in polymers.** Morgan, R.J.; Mones, E.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Mar 1979. Contract W-7405-ENG-48. 8p. (CONF-790917—2). Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The effects of low-molecular-weight chemicals on the physical integrity and failure modes of amorphous but crystallizable polycarbonate and crosslinked epoxy glasses are presented. Solvent-induced crystallization (SINC) is shown to play a role in the solvent-crazing mechanism of polycarbonate. A mechanically weak, cavitated, crazed surface layer is produced in polycarbonate as a result of a combination of volume decreases caused by SINC and liquid-induced dilatational swelling stresses together with the relaxation of fabrication stresses. The mechanism by which surface crazing in polycarbonate is enhanced by handling is also reported. In the epoxy studies, sorbed moisture plasticizes these crosslinked glasses and causes their mechanical properties to deteriorate. Studies of the initiation cavity and mirror regions of the fracture topographies of these epoxies indicate sorbed moisture enhances the craze initiation and propagation processes.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 55307

DEGRADATION AND EROSION

REFER ALSO TO CITATION(S) 54196

55308 (UCRL—82627) **Effect of A high explosive environment on polycarbonate degradation.** Alhouse, L.P.; Hoffman, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 27p. (CONF-790632—8). Dep. NTIS, PC A03/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

In the presence of high explosives such as 1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetraazacyclooctane (HMX) and penaerythritol tetranitrate (PETN) at moderate temperature (70°C), poly[oxycarbonyloxy-1, 4,-phenylene isopropylidene- 1, 4 phenylene], commonly known as Lexan polycarbonate, degradation is accelerated. Degradation acceleration is indicated by a reduction in glass transition temperatures of from 8 to 12°C and a decrease in viscosity average molecular weight of polycarbonate samples aged in direct contact with these explosives as compared to polycarbonate kept at 32°C in the absence of high explosives. Three major degradation mechanisms are involved: (1) chain scission; (2) crosslinking; and (3) intrachain rearrangement. Yellow polymer degradation products similar to those found in polycarbonate photo and high energy radiation degradation products intensify as the high explosive - polymer interface is approached. This implies that active species from the explosive thermal decomposition are responsible for acceleration of the chemical degradation of the polycarbonate. The physical properties of polycarbonate annealed below its glass transition temperature change gradually. A clustering phenomena has been proposed to explain the observed decrease in impact resistance and increase in strength of annealed polycarbonates. Although polycarbonate in the high explosive environment became brittle, we were unable to conclusively demonstrate any clustering phenomena in these polycarbonate other than that due to highly crosslinked degradation products.

OTHER MATERIALS

REFER ALSO TO CITATION(S) 54026

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 55304

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 54334, 54338, 54339, 54340, 54341, 55312

PROPERTIES

REFER ALSO TO CITATION(S) 54066, 54334, 54344, 54345, 54348, 54353, 54361, 54363, 54401, 55148, 55155, 55312, 55653

55309 (BNL—26646) **Modifications in optoelectronic behavior of plasma-deposited amorphous semiconductor alloys via impurity incorporation.** Griffith, R.W.; Kampas, F.J.; Vanier, P.E.; Hirsch, M.D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 7p. (CONF-790851—3). Dep. NTIS, PC A02/MF A01.

From 8. international conference on amorphous and liquid semiconductors; Cambridge, MA, USA (27 Aug 1979).

Electronic properties of plasma-deposited a-Si:H alloys are discussed as functions of oxygen and nitrogen impurities. Over a wide range of processing conditions, features displayed by the data include: (1) anomalous behavior in photoconductivity versus temperature for films deficient in either, or both, impurities (peaks appear that are associated with thermal-quenching processes and supralinearity); (2) modification to classic behavior in photoconductivity owing to synergistic effects of oxygen and nitrogen. Correlations with photoluminescence are presented. Optical emission spectroscopy is discussed within the context of an emerging spectroscopy for the detection of emitting reactive species in the plasma. The presence of impurities, particularly N_2, can be diagnosed.

55310 **Electrical conduction in glassy carbon.** Saxena, R.R.; Bragg, R.H. (Univ. of California, Berkeley). *J. Non-Cryst. Solids;* **28**: 45-60(1978).

The electrical conductivity and Hall effect of a disordered carbon have been investigated in the temperature range 10 to 300°K and magnetic fields up to 50 KG. The structure of the material was changed by heat treating in the temperature range 1000 to 2800°C. For heat treatment temperatures (HTT) greater than 2000°C the conductivity was found to be the sum of a temperature-independent contribution due to diffuse boundary scattering and a hopping contribution following a T⁻/sup 1/4/ law. For HTT less than 2000°C, at the lowest measurement temperatures the conductivity exhibits a

logarithmic temperature dependence characteristic of Kondo systems. An energy band structure for these disordered carbons is proposed in which the Fermi level is pinned by localized states.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 54401, 55762

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 55759

55311 (INIS-mf—4903, pp 134-137) **Mechanism of radiation damage in structural graphite under high fluence irradiation.** Kurolenkin, E.I.; Virgil'ev, Yu.S. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

Regularities of void formation are considered for the "secondary" irradiation-induced swelling of structural carbon materials. This swelling is observed after pre-shrinkage of materials under neutron irradiation. It is assumed that two processes are resulted in the secondary swelling. One is the increase in void volume in a crystal up to its saturation. The other is the transformation of these voids into macrovoids (microcracking). At irradiation temperatures of 1200 to 1300 deg C the void formation is minimized for graphites with 150 < Lsub(c) < 300A, where Lsub(c) is grain size.

55312 (INIS-mf—4905, pp 41-51) **Effects of irradiation conditions on anomalous expansion of fine-grained diamond.** Nikolaenko, V.A. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

The paper is concerned with the experimental results for a fine-grained dispersed diamond irradiated under different conditions. It is shown that the excessive expansion of the fine-grained diamond crystal lattice depends on the neutron flux density. The lower the neutron flux density is and, consequently, the longer irradiation time (for a given neutron flux) is, the larger expansion is observed. This additional expansion of the diamond lattice is explained by annealing of the surface defects which prevent from the expansion.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 54400, 54403

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 54061, 55541, 55614

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 54059, 54214

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 54080, 54251, 55324

55313 (CONF-790859—1) **Investigation of Cerenkov counting of environmental strontium-90.** Reynolds, S.A.; Eldridge, J.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From International conference on liquid scintillation counting--recent applications and development; San Francisco, CA, USA (21 Aug 1979).

A typical liquid scintillation counter was evaluated for detection of low levels of ^{90}Sr-Y. A blank of about 5 cpm and ^{90}Y efficiency of 42% were obtained for 20-ml samples. The corresponding minimum detectable concentration for a 100-minute count is 0.03 pCi/ml, so that measurement of water samples can readily be made at the maximum permissible concentration for ^{90}Sr, 0.3 pCi/ml. The efficiency for ^{90}Sr is less than 0.4%, 1.4% for ^{137}Cs, and less than 0.04% for gamma-emitting ^{85}Sr, a useful tracer. Some data for ^{90}Y efficiencies and blanks are given for other liquid scintillation counters. Chemical treatments are necessary in some cases to concentrate ^{90}Sr-Y, to remove colored substances which cause quenching, or to eliminate interfering radionuclides. However, the manipulations need not be as elaborate as in conventional radiochemical analysis methods for ^{90}Sr. Ferric ion (yellow) quenches at the 5 ppM level, but the interference can be eliminated by adding a reducing agent. The Rn daughter ^{214}Bi, an interfering radionuclide, disappears by decay in 2-3 hours after removal of Rn by sweeping with air or gas. Concentration-separation methods studied have included precipitation and ion exchange.

55314 (NLCO—1160) **Radiometric determination of ^{233}U in thorium.** Humphrey, H.W.; Adkins, E.L. (National Lead Co. of Ohio, Cincinnati (USA)). Aug 1979. Contract EY-76-C-05-1156. 42p. Dep. NTIS, PC A03/MF A01.

An alpha spectrometric method has been developed for the determination of trace levels of ^{233}U in a thorium matrix. Uranium is selectively removed from thorium and other macro-impurities (except Fe) by passage through an AGl-X8 anion exchange resin in the Cl^- form. Further purification of uranium for removal of iron is accomplished by passage through an AGl-X8 anion exchange resin in the NO^-_3 form. Natural uranium is used as both a carrier and an internal yield correcting standard. The assay is relatively interference free, except for inherent uranium, which can be tolerated up to 1800 ppM, with only a 1% negative bias. Three duplicate assays in the range of 0.1 to 55 ppM ^{233}U can be performed to a relative standard deviation of +- 7.1%, or better in approximately twelve hours (including counting).

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 54025, 54045, 54152, 55491

55315 (CONF-790819—6) **Pulsed dye laser OAS with a Helmholtz resonator cell.** Shaw, R.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From Topical meeting on photoacoustic spectroscopy; Ames, IA, USA (1 Aug 1979).

A Helmholtz resonator cell for simplifying pulsed dye laser-excited optoacoustic signals is described and employed for high resolution OAS of holmium oxide powder.

55316 (IS-T—868) **Applications of pulsed nuclear magnetic resonance to chemistry: multiple-pulse NMR, cross polarization, magic-angle spinning annd instrumental design.** Murphy, P.D. (Ames Lab., IA (USA)). Jul 1979. Contract W-7405-ENG-82. 225p. Dep. NTIS, PC A10/MF A01.

Pulsed Nuclear Magnetic Resonance (NMR) has been applied to: (1) Measurements of the prinicpal components of the proton shielding tensors of the hydrides of zirconium chloride and zirconium bromide. Multiple-Pulse techniques have been used to remove static homonuclear dipolar coupling. The anisotropies and isotropic shifts of these tensors have been used to infer the possible locations of the hydrogen within the sandwich-like layers of these unusual compounds. (2) Studies of the oscillatory transfer of magnetic polarization between ^{1}H and ^{29}Si in substituted silanes. The technique of J Cross Polarization has been used to enhance sensitivity. The ^{29}Si NMR shifts of -Si-O- model compounds have been investigated as a possible probe for future studies of the environment of bound oxygen in coal-derived liquids. (3) Measurements of the aromatic fraction of ^{13}C in whole coals. The techniques of ^{1}H-^{13}C Cross Polarization and Magic-Angle Spinning have been used to enhance sensitivity and remove shift anisotropy. Additional topics described are: (4) Calculation and properties of the broadened lineshape of the shileding Powder Pattern. (5) Calculation of the oscillatory transfer of magnetic polarization for an I-S system. (6) Numerical convolution and its uses. (7) The technique of digital filtering applied in the frequency domain. (8) The designs and properties of four NMR probe-circuits. (9) The design of a single-coil double-resonance probe for combined Magic-Angle Spinning and Cross Polarization. (10) The designs of low Q and high Q rf power amplifiers with emphasis on the rf matching circuitry.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 55439

55317 (IS-M—187) **Anion chromatography with low-conductivity eluents.** Gjerde, D.T.; Fritz, J.S.; Schmuckler, G. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 30p. (CONF-790931—2). Dep. NTIS, PC A03/MF A01.

From 14. international symposium on advances in chromatography; Lausanne, Switzerland (24 Sep 1979).

A new and very simple system is described for separation and determination of mixtures of inorganic and organic anions. The column is filled with a macroporous anion-exchange resin of 0.007 to 0.07 meq/g exchange capacity. The eluent is a very dilute (0.0001 to 0.00065 M) solution of an organic acid salt, such as potassium benzoate or phthalate. The eluent conductance is sufficiently low that the separated anions can be detected with a simple conductance detector. Numerous examples of actual separations are shown. In some cases concentrations of anions below 1 ppM could be detected. The applicability of the new system to real samples is demonstrated by several examples. 10 figures, 2 tables.

55318 (ORNL/TM—6972) **Reverse-phase high-performance liquid chromatograph studies of trialkylphosphorous compounds using differential refractive index detection.** Manning, D.L. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 15p. AT.

Reverse-phase liquid chromatographic studies were carried out on selected neutral classes of trialkylphosphorous compounds which act as extractants in nuclear fuel technology. For the high-performance liquid chromatograph (HPLC) studies, we used a 25-cm Partisil 10-ODS-2 column and methanol-water as the mobile phase. These organophosphorous compounds show weak ultraviolet (uv) absorbance; therefore, we used a differential refractive index monitor. Elution parameters were determined for substances which are representative of the trialkyl phosphate, dialkylalkyl phosphonate, and trialkylphosphine oxide class of compounds.

55319 **Ion chromatographic determination of dibutylphosphoric acid in nuclear fuel reprocessing streams.** Lash, R.P.; Hill, C.J. (Allied Chem Corp, Idaho Falls, Idaho). *J. Liquid Chromatogr.;* **2**: No. 3, 417-427(1979).

A rapid method has been developed for the determination of dibutylphosphoric acid (DBP), a degradation product of tributylphosphate (TBP), which is used in a solvent extraction process for recovery of uranium. DBP along with any monobutylphosphoric acid (MSP) and phosphoric acid are extracted from the organic phase into dilute sodium hydroxide. DBP is separated from MBP and phosphoric acid by ion chromatography and is determined on a peak height ratio basis. The method requires only 30 minutes per analysis as compared to the conventional alumina column separation-colorimetric determination procedure which requires 8 h to complete. DBP has been quantified to a lower limit of 1.5 mg/L. Relative standard deviations ranging from 5.7% to 0.4% were obtained for DBP concentrations ranging from 1.5 to 500 mg/L, respectively.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 55339

55320 (CONF-790538—18) **Diffusion and ionic conductivity in solid electrolytes.** Mundy, J.N. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

In ionic solids, the most usual experimental method of determining the correlation factor (f) has been a comparison of tracer diffusion and ionic conductivity. Theoretical values of f have been determined for many lattice geometries and jump processes and compared with measured values of f as a means of determining the atomic jump process. This paper considers the problems of applying this technique to solid electrolytes where the concentration of defects responsible for diffusion is comparable to the concentration of the mobile ions. The difficulties of applying the more common experimental techniques are discussed and the present level of theoretical understanding of correlation effects will be outlined.

55321 (COO—2793-15) **Double resonance spectroscopy of multiple-photon excited molecules.** Steinfeld, J.I.; Jensen, C.C.; Anderson, T.G.; Reiser, C. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 1979. Contract EY-76-S-02-2793. 10p. (CONF-790720—3). Dep. NTIS, PC A02/MF A01.

From 4. international congress LASER 79 opto-electronics; Munich, F.R. Germany (2 Jul 1979).

A diode-infrared laser-double resonance investigation was conducted of the initial photon absorption step ($\nu_3 \leftarrow 0$) in SF_6. A variety of double resonance effects were observed: two-level, three-level, and four-level. It is concluded that diode-infrared laser double resonance can be used to study multiple photon excitation in polyatomic molecules and vibrational levels above the first excited state onto the quasi-continuum. 4 figs. (DLC)

55322 (LMSC/D—672696) **Evolution of reaction profiles in porous zinc electrodes.** Katan, T.; Bergeron, P.J.; Szpak, S. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.; Naval Ocean Systems Center, San Diego, CA (USA)). 1979. Contract EM-78-C-01-5153. 4p. (CONF-791017—7). Dep. NTIS, PC A02/MF A01.

From 7. international conference on chemical vapor deposition; Los Angeles, CA, USA (14 Oct 1979).

During discharge at constant current, white ZnO formed first at the mouth of the Zn pore. After 0.1-cm penetration, a second, dark-gray product also moved into the pore. Bare Zn could be distinguished as the third reaction front penetrating slowly before the electrode passivated. The polarization behavior depended upon whether the current was larger or less than 5 mA. The amount of charge that could be accumulated before hydrogen evolved, depended on the current also: 1000 mC at 0.1 mA, 50 mC at 3 mA. (DLC)

55323 (MLM—2617(OP)) **New hydridic rare earth compounds.** Silver, G.L. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract AC04-DP7600053. 4p. (CONF-790641—2). Dep. NTIS, PC A02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

Results from experimentation in which lanthanide metal chips were dissolved in dilute aqueous acids are discussed. Most members of the lanthanide family (including yttrium) have been found to produce unexpected precipitates when dissolved in solutions of acetic acid and some of its derivatives. Europium is an exception, however, perhaps because the divalent europium cations produced by the dissolution of europium metal cannot form the new compounds formed by trivalent lanthanide cations. The colors of the precipitates formed by the dissolution reactions in dilute acetic acid are dark for the lighter lanthanides (black or nearly black for lanthanum and cerium, brown for neodymium and praseodymium, and yellow for samarium and heavier lanthanides). Yields of the precipitates in the dissolution reactions appear to diminish with increasing atomic weight of the rare earth element, whereas stability against decomposition and ease of isolation seem to be maximized for neodymium, praseodymium, and samarium. All the newly isolated compounds appear to be characterized by an interplanar spacing of about 0.31 nm. This line in the powder diffraction patterns of the new compounds appears to diminish in magnitude with increasing atomic weight of the parent lanthanide in these new compounds, perhaps illustrating a curious example of the lanthanide contraction. Thermogravimetric and differential thermal analysis of the new compounds indicates a low degree of thermal stability. All the compounds lose weight when heated in nitrogen, and this weight loss may begin at a temperature as low as 50°C. Violent decomposition has been observed in some examples at 110°C.

55324 (RHO-SA—113) **Determination of water solubility in organic liquids.** Hunter, C.H.; Honaker, C.B. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1979. Contract EY-77-C-06-1030. 11p. (CONF-790666—5). Dep. NTIS, PC A02/MF A01.

From 34. Northwest regional meeting of the American Chemical Society; Richland, WA, USA (13 Jun 1979).

It is necessary to determine the solubility of water in organic liquids such as cyclohexanone, when the amount of dissolved water would affect the extractive power of the organic liquid. Methods previously used to determine the solubility of water in organic liquids include titration, gas chromatography and refractive index measurements. Use of a tritium tracer is an easier and more accurate method. The limits of detection are lower and the dynamic range is larger. The method in this study determines the uptake of water in cyclohexanone by using a tritium tracer. Samples are spiked with tritiated water and aliquots of the organic phase are counted by liquid scintillation. The experimental procedure is described and results are discussed.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

55325 (MLM-MU—79-66-0004) **Krypton-85 enrichment by advanced thermal diffusion.** Schwind, R.A.; Avona, V.L.; Roos, W.J. (Monsanto Research Corp., Miamisburg, OH (USA)). 1 Jun 1979. Contract EY-76-C-04-0053. 91p. Dep. NTIS, PC A05/MF A01.

The feasibility of enriching /sup 85/Kr to 90% by advanced gas-phase thermal diffusion was assessed. The assessment consisted of: (1) fabrication and operation of two thermal diffusion columns of new designs, and construction and operation of a thermosiphon gas circulation system; (2) preparation of two conceptual design studies, one for fabrication of a /sup 85/Kr enrichment system capable of producing 10,000 Ci/yr of 90% /sup 85/Kr with the system located in an existing building at Mound, and the second for a system of the same capacity, but with the system located in a newly constructed building; and (3) a market survey to determine the likely extent of demand for such material. The experimental results with the new columns were highly satisfactory, and it is now known with certainty that columns of these designs can be used in a production system. Two conceptual design studies were performed to evaluate the possibility of fabricating the separation facility with alternative types of funding, and the impact of each option on possibilities for future expansion of production capacity. The market survey that was conducted provided information that led to the following conclusions: (1) Demand reflected in response to the survey was not extremely large; however, there are several large applications that appear to have real potential in the future. (2) Lack of an assured supply of /sup 85/Kr at sufficiently high enrichments and/or predictable prices appears to be having a serious negative impact on development of uses for such material. Availability of adequate quantities of unenriched (~5%) /sup 85/Kr is likely to be a serious

problem, at least in the near term (i.e., within the next 5 yr). This potential problem merits immediate close attention. (3) A definitive survey cannot be completed on a one-shot basis.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 54097, 55306, 55308

55326 (COO—4695-2) **Energy dispersion and relaxation in propynal using laser ir/visible double resonance.** Lesiecki, M.L.; Smith, G.R.; Stewart, J.A.; Guillory, W.A. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). 1979. Contract ER-78-S-02-4695. 18p. (CONF-790919—1). Dep. NTIS, PC A02/MF A01.

From 14. European congress on molecular spectroscopy; Frankfurt, F.R. Germany (3 Sep 1979).

The dynamics of energy dispersion in propynal has been studied over the pressure range of 5 to 500 mtorr following excitation by a TEA CO_2 laser below the dissociation threshold. Wavelength resolved spectra, using the dye laser-induced fluorescence technique, are used to characterize the vibrational levels that are involved in the various energy transfer processes, while time-resolved spectra are used to determine the corresponding rates. The rate constants are extrapolated to zero pressure to obtain the regime of collisionless intramolecular relaxation time. Mechanisms of energy dispersion involving each of the probed vibrational levels ($v = 0$, $\nu_6(v = 1)$, $\nu_9(v = 1)$, and $\nu_4(v = 1)$) are discussed.

55327 (ORO—3018-T2) **Ultraviolet photoelectron spectroscopic studies of dicarboxylic acids and phosphorus compounds.** Chattopadhyay, S.K. (Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry). Aug 1979. Contract EY-76-S-05-3018. 117p. Dep. NTIS, PC A06/MF A01.

Thesis.

The investigation of dicarboxyl compounds was undertaken to study the interaction of the carbonyl oxygen lone-pair orbitals. The spectra of these compounds were interpreted in terms of the through-bond nature of the interactions involving n-MO's in dicarboxyl compounds, the through-space nature of the interaction between π_0 MO's of these compounds, the effect of O-alkylation on π_0 - MO, and the composite-molecule approach. The UPS of a series of phosphorus compounds were obtained and the MO assignments made. The changes in the spectral features of phosphites relative to those of the phosphates can be explained in terms of σ-donation and π-acceptance properties of phosphites. Finally, the effects of substitution as well as symmetry lowering can be utilized to rationalize the changes in spectra in going from phosphates to substituted phosphates.

55328 (ORO—3861-28) **Vacuum ultraviolet electronic properties of liquids. Annual progress report, November 1, 1978-October 31, 1979.** Painter, L.R. (Tennessee Univ., Knoxville (USA). Dept. of Physics). 1979. Contract EY-76-S-05-3861. 13p. Dep. NTIS, PC A02/MF A01.

The following materials were studied: formamide, hexamethylphosphorictriamide, polyethylene, Kapton, anthracene, and several aromatics. Properties determined included optical and related properties, but no data is included in this report. (DLC)

55329 (UCRL-Trans—11488) **Method for manufacturing 4-pyrones.** Takasu, I.; Hotta, H. Jun 1979. Translation of . Japanese Patent 29512-1972. 15p. Dep. NTIS, PC A02/MF A01.

The method comprises subjecting the compounds $R_1OCXCHCOCH_3$ and $YCOOR_2$ to a alkanol-removing condensation reaction and then subjecting the product and a transesterification reaction to ring closure treatment. The 4-pyrones have the formula CXCHCOCHCZO. (DLC)

55330 (UCRL-Trans—11489) **Method for manufacturing 2-methyl-4H-pyran-4-one.** Takasu, I.; Hotta, H. Jun 1979. Translation of . Japanese Patent 21105-1970. 7p. Dep. NTIS, PC A02/MF A01.

A method for manufacturing 2-methyl-4H-pyran-4-one comprises the ring closure treatment of dialkylacetals of β,δ-dioxocapronaldehyde as indicated by the general formula $(R^1O)_2CHCH_2COCH_2COCH_3$, (in which formula, R^1 indicates a lower alkyl group) to obtain 2-methyl-4H-pyran-4-one.

55331 **Carbon-13-enriched carbohydrates: preparation of triose, tetrose, and pentose phosphates.** Serianni, A.S.; Pierce, J.; Barker, R. (Michigan State Univ., East Lansing). *Biochemistry;* **18**: No. 7, 1192-1199(3 Apr 1979).

Three-, four-, and five-carbon aldononitrile phosphates were prepared, purified, and catalytically reduced with palladium-barium sulfate (5%) to the corresponding aldose phosphates in high yields at pH 1.7 +- 0.1 and atmospheric pressure. DL-Glyceraldehyde 3-phosphate and the tetrose 4-phosphates were prepared with carbon-13 enrichment at C-1, while the pentose 5-phosphates were prepared with enrichment at C-1 and C-2. Preparations of glycolaldehyde phosphate and D-glyceraldehyde 3-phosphate by lead tetracetate oxidation of glycerol phosphate and fructose 6-phosphate, respectively, are described. The proportions of cyclic hemiacetals and linear gem-diol forms of the two- to five-carbon aldose phosphates in aqueous solution are reported. Carbon-13 chemical shifts and carbon-phosphorus and carbon-hydrogen coupling constants for the furanose phosphate ring and linear gem-diol phosphates are reported and discussed. D-[2-^{13}C]Ribulose 1,5-bisphosphate and L-[3,4-^{13}C]sorbose 1,6-bisphosphate were prepared enzymatically from D-[2-^{13}C]ribose 5-phosphate and DL-[1-^{13}C]glyceraldehyde 3-phosphate, respectively.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 55172

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 55321, 55558

55332 (LA-tr—79-27) **Quantum chemistry: concerning the excited states occurring in the photochemical reactions of α-pyrone, γ-pyrone, coumarin, and chromone.** Bouanini, H.; Gayoso, J. Translated from *C. R. Hebd. Seances Acad. Sci., Ser. C;* **276**: 399-402(1973). 12p. Dep. NTIS, PC A02/MF A01.

The π electron structures are discussed. The photochemical reaction mechanisms are studied. Results confirm the hypothesis that the photochemically active states are the $\pi\pi^*$ excited states. (DLC)

55333 **Photophysics and photochemistry of formaldehyde.** Baronavski, A.P.; Cabello, A.; Clark, J.H.; Haas, Y.; Houston, P.L.; Kung, A.H.; Moore, C.B.; Reilly, J.; Weisshaar, J.C.; Zughul, M.B. (Univ. of California, Berkeley). pp 108-121 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

In the discussion on the photophysics and photochemistry of formaldehyde the following topics are covered: lifetimes of optically excited states; kinetic spectroscopy of the dissociation products; and photochemical processes and products.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 54045

55334 (COO—1385-76) **Electron spin resonance studies of radiation effects. Final report, 1964-1979 (including annual progress reports for 1978 and 1979).** Rogers, M.T. (Michigan State Univ., East Lansing (USA)). Jul 1979. Contract EY-76-S-02-1385. 27p. Dep. NTIS, PC A03/MF A01.

The discovery of new free radicals, largely in irradiated single crystals of nonmetallic solids, and the determination of the molecular and electronic structures of these paramagnetic species by electron spin resonance (ESR) spectroscopy, have been carried out using a wide variety of organic and inorganic materials. The mechanisms of production of radicals in solids, their motions, and their reactions have been investigated and some applicable general principles deduced. Emphasis has been on aliphatic free radicals from irradiated carboxylic acids and amides and their halogen-substituted derivatives, organometallic radicals and substituted cyclic hydrocarbon radicals; inorganic radicals studied include V centers, hypervalent radicals and electron adducts. Extensive investigations of paramagnetic transition metal complexes, particularly cyanides and fluorides, have been made. In all cases quantum mechanical calculations have been employed as far as possible in interpreting the data. An improved method for analyzing experimental ESR spectra of single crystals has been developed and a number of crystal structures have been determined to supplement the ESR studies. Applications of nuclear quadrupole resonance spectroscopy to the study of structure and bonding in inorganic solids have been made and a method for using nuclear magnetic relaxation data for estimating quadrupole coupling constants in liquids has been developed.

55335 (COO—3212-47) **Progress report, Contract No. EY765023212*000.** Box, H.C. (Roswell Park Memorial Inst., Buffalo, NY (USA)). Jun 1979. Contract EY-76-S-02-3212. 5p. Dep. NTIS, PC A02/MF A01.

Electron trapping in irradiated single crystals was investigated using the ENDOR method. ^{13}C NMR spectroscopy was used in conjunction with ^{13}C enrichment to observe effects of agents on

biomolecules. Primary free radical radiation products were characterized from ESR-ENDOR measurements on irradiated carbohydrate crystals.

55336 (NDRL—1996) **Radiation Laboratory quarterly report, January 1, 1979-March 31, 1979.** (Notre Dame Univ., IN (USA). Radiation Lab.). 1979. Contract EY-76-C-02-0038. 53p. Dep. NTIS, PC A04/MF A01.

Investigations in progress are briefly summarized. Abstracts of the reports published during the first quarter of 1979 are included. Examples of the investigations in progress are electron mobility in liquid alkanes, thermal electron attachment to molecules at high pressures, time-resolved ESR studies of the solvated electron in THF, electron transfer reactions involving acridine, and Raman intensity pattern in polyene aldehydes.

55337 (ORO—4063-T1) **Basic and engineering studies of radiation induced reactions in the liquid phase. Final technical report, June 1, 1970-May 31, 1974.** (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Jun 1978. Contract EY-76-S-05-4063. 46p. Dep. NTIS, PC A03/MF A01.

Laboratory studies reported on are ionic polymerization under superdry conditions, emulsion polymerization, and vinyl chloride polymerization. Engineering studies include the effect of moisture level on radiation-induced solution polymerization, effect of dose rate on radiation-induced emulsion polymerization of styrene, the effect of soap exchange in styrene emulsion polymerization, pilot plant studies of radiation induced emulsion polymerization of vinyl chloride, pilot plant studies of radiation-induced emulsion copolymerization of vinyl chloride with vinyl acetate, pilot plant study of radiation-induced graft emulsion polymerization of styrene onto polyvinyl chloride and poly(vinyl chloride-vinyl acetate), and radiation-induced precipitation polymerization of vinyl chloride in a flow reactor.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

55338 (COO—1713-84) **Reaction studies of hot silicon and germanium radicals. Progress report, September 1, 1978-August 31, 1979.** Gaspar, P.P. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). 31 Aug 1979. Contract EY-76-S-02-1713. 25p. Dep. NTIS, PC A02/MF A01.

The experimental approach to attaining the goals of this research program is briefly outlined and the progress made in the last year is reviewed in sections entitled: (a) Primary steps in the reaction of recoiling silicon and germanium atoms and the identification of reactive intermediates; (b) Thermally induced silylene and germylene reactions; (c) Silicon free radical chemistry; (d) The role of ionic reactions in the chemistry of recoiling silicon atoms.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 54682, 55578, 55579, 55613

55339 (DP-MS—79-29) **Preparation and Moessbauer spectra of Np(III): alkali metal chlorocompounds.** Karraker, D.G.; Stone, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 8p. (CONF-790917—5). Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

M_2NpCl_5, MNp_2Cl_7 (M = K, NH_4, Rb) and $NpCl_3$ $4CH_3CN$ were prepared by zinc amalgam reduction of $NpCl_4$-MCl in 50:1 acetonitrile-propionic acid solutions. The ^{237}Np Moessbauer spectra of these compounds showed quadrupole interactions, with Moessbauer parameters δ = 3.4 to 3.5 cm/sec and 1/4eqQ = 0.5 to 0.7 cm/sec. Moessbauer spectra established that preparations analyzing as $MNpCl_4$ CH_3CN were mixtures of M_2NpCl_5 and $NpCl_3$ $4CH_3CN$.

55340 (RHO-SA—84) **Actinide chemical speciation preliminary considerations.** Metcalf, S.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1978. Contract EY-77-C-06-1030. 5p. (CONF-7810208—1). Dep. NTIS, PC A02/MF A01.

From Actinide environmental research workshop; Airlie, VA, USA (10 Oct 1978).

In the nuclear industry the development of techniques to identify and quantitate specific forms of radionuclides in the environment is a pressing need. The chemical form (species) of radionuclides dominates their impact on and fate in the environment. Chemical speciation methods development and research being initiated by Rockwell Hanford Operations at the Hanford site is discussed.

55341 (UCRL—82381) **Decommissioning a tritium glove-box facility.** Folkers, C.L.; Homann, S.G.; Nicolosi, A.S.; Hanel, S.L.; King, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Aug 1979. Contract W-7405-ENG-48. 15p. (CONF-790923—2). Dep. NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

A large glove-box facility for handling reactive metal tritides was decommissioned. Major sections of the glove box were decontaminated and disassembled for reuse at another tritium facility. To achieve the desired results, decontamnation required repeated washing, first with organic liquids, then with water and detergents. Worker protection was provided by simple ventilation combined with careful monitoring of the work areas and employees. Several innovative techniques are described.

RADIOISOTOPE PRODUCTION

55342 **Preparation of ^{52}Fe and its use in a ^{52}Fe/sup 52m/Mn generator.** Ku, T.H.; Richards, P.; Stang, L.G. Jr.; Prach, T. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Radiology;* 132: No. 2, 475-477(Aug 1979).

Clinically useful quantities of ^{52}Fe have been prepared at the Brookhaven Linac Isotope Producer (BLIP) by bombarding manganese or nickel targets with medium energy protons. After chemical separation, ^{52}Fe is loaded onto a generator column from which carrier-free /sup 52m/Mn is eluted. The /sup 52m/ Mn generator is potentially useful in emission computed tomography.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 54097

55343 (LBL—9487) **Theoretical study of a reaction-diffusion model for flame propagation in a gas.** Lin, S.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 114p. Dep. NTIS, PC A06/MF A01.

A system of two equations of a reaction-diffusion model for flame propagation in a gas contains a parameter, the Lewis number, which is the ratio of the heat conduction coefficient to the coefficient of chemical species diffusion. If the existence of a positive ignition temperature is assumed, then it is proven that, for arbitrary Lewis number, (a) there exists a unique flame front associated with each unburned gas state. When the Lewis number is one, the model equation can be reduced to a scalar reaction-diffusion equation. It is proven further that (b) if the initial gas states are close to a flame front, then the gas mixture evolves into the flame front at an exponential rate. In particular, each flame front is stable under finite amplitude perturbation. (c) For general initial gas states, the gas mixture evolves asympotically into a suitable combination of flame fronts. In the case of Lewis number equal to one, the dependence of the flame speed on the ignition temperature is discussed. It is found that (d) the flame speed increases monotonically to a finite limit as the ignition temperature tends to zero. Moreover, it is proven that (e) without the assumption of a positive ignition temperature, there exists a family of traveling wave solutions connecting the same unburned and burned gas states. The limit flame speed of (d) is the minimal wave speed of (e). The results of (d) and (e) give the first proof that it is not essential to assume the existence of a positive ignition temperature in order for a flame front to be formed. However, evidence shows that, without the assumption of a positive ignition temperature, the flame front may fail to be stable under finite amplitude perturbations.

55344 (SAN—0034/243-1) **Detailed combustion of sulfur compounds. Final progress report.** Muller, C.H. III; Schofield, K.; Steinberg, M.; Broida, H.P. (California Univ., Santa Barbara (USA). Quantum Inst.). 14 Sep 1978. Contract EY-76-S-03-0034-243. 12p. Dep. NTIS, PC A02/MF A01.

A study of the detailed chemistry of sulfur was carried out in atmospheric pressure premixed $H_2/O_2/N_2$ flames containing traces of sulfur. The objective was to investigate the thermodynamics and kinetics of the coupled chemistry of the sulfur intermediates in these flames. A kinetic model was developed for the coupled sulfur chemistry in $H_2/O_2/N_2$ flames. Thermodynamic checks have validated the laser fluorescence measurements of several sulfur species and OH. The study has demonstrated laser induced fluorescence as a powerful diagnostic technique which promises to enhance our understanding of combustion processes.

ENGINEERING

GENERAL ENGINEERING

55345 (LA-UR—79-1826) **CAD/CAM in the LASL shop department.** Colston, E.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 25p. (CONF-7904101—1). Dep. NTIS, PC A02/MF A01.

From IMOG machine tool subgroup meeting; Los Alamos, NM, USA (10 Apr 1979).

Manufacturing and Consulting Services, Inc. AD-2000 Interactive Graphics software is used on an Interdata 7/32 computer system. The arrangement of the system is described. Capabilities of the system are illustrated by a number of figures taken from the graphics terminal screen. 21 figures. (RWR)

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 55151, 55411

55346 (CONF-790615—27) **Test of thick vessel with a flaw in residual stress field.** Bryan, R.H.; Iskander, S.K.; Holz, P.P.; Merkle, J.G.; Whitman, G.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

Intermediate test vessel V-8, a 152-mm-thick vessel fabricated of SA533, grade B, class 1 steel, was pressurized to failure at -23°C. The vessel contained a fatigue-sharpened notch adjacent to a half-bead weld repair that had not been stress relieved. Residual stresses and fracture toughnesses were determined before the pressure test by measurements on a prototypical weld, and fracture predictions were made by linear elastic fracture analysis. Predictions agreed well with test results, demonstrating the important influence of high residual stresses on fracture behavior.

55347 **Vital role of experimental stress analysis in the numerical design of structures and components.** Patterson, C. pp 329-334 of 6. Internationale Konferenz 'Experimentelle Spannungsanalyse'. Duesseldorf, Germany, F.R.; VDI-Verl. (1978).

From 6. conference on experimental stress analysis; Munich, F.R. Germany (18 Sep 1978).

After a discussion of structural design philosophy when using numerical techniques and of the physical and numerical processes commonly used, some areas where experimental stress analysis has a persisting vital role in the design process are identified. These are: In the validation of simplified numerical models for economic design; in the provision of necessary data, such as in damping problems, from which to formulate a numerical model; in the provision of material data over wide operating ranges, particularly variations with temperature; and in the breaking of new ground by the conjoint use of numerical and experimental techniques to resolve complex physical mechanismus.

55348 (LA-UR—79-662) **Design and performance of a magnetic refrigerator and heat engine.** Barclay, J.A.; Steyert, W.A.; Zrudsky, D.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790901—4). Dep. NTIS, PC A02/MF A01.

From 15. international congress on refrigeration; Venice, Italy (23 Sep 1979).

The initial operation of the refrigerator/heat engine is very encouraging. The analysis indicates that the magnetic field profile and inefficient water pump are the main reasons for the limited ΔT. The next experiments will be performed with soft iron shielding to increase ΔH and also with a more efficient pump to reduce the heat load. The prognosis is very good. The basic advantages of magnetic refrigerators/heat engines are that the energy density in the working material is very high, 25 kJ/l of Gd at 300 K; the heat exchange is between a solid and a liquid which makes the regenerative stages of the cycle more efficient; and in some cases the expensive external heat exchangers could be eliminated. The disadvantage of magnetic refrigeration is that a superconducting magnet is required. An example of an application at room temperature is a magnetic heat pump for utilization of low-grade waste heat such as in nuclear power plants. For applications such as this, where external heat exchangers may be eliminated, the economics look attractive. The prospects for magnetic refrigeration at low temperatures ($< 77K$) look much better than at room temperature because the ratio of magnetic entropy to lattice entropy increases rapidly as the temperature decreases.

55349 (SAND—78-8175) **Heat transfer in packed beds at low Reynolds number. Final report.** Prenger, F.C. Jr. (Martin Marietta Corp., Denver, CO (USA)). Dec 1977. Contract EY-76-C-04-0789. 94p. Dep. NTIS, PC A05/MF A01.

Results from an experimental investigation of heat transfer in packed beds of low thermal conductivity particles is presented. At low Reynolds number flows through beds of fine particles the gas temperature and solids temperature differ substantially. An analytical model is proposed which treats this mechanism and is consistent with experimental results. A test apparatus was constructed and experimental results were obtained using air flowing through packed beds of sodium chloride and calcium chloride. Four heat transfer parameters were identified; bed thermal conductivity, heat transfer coefficient between the interstitial gas and the solids, and two heat transfer coefficients for the coolant tubes; one between the coolant tubes and the interstitial gas and one between the coolant tubes and the solid particles. Each coefficient is presented in terms of a single correlating parameter. A comparison between the analytical model and the test data for selected cases is also presented.

55350 (UCRL—83200) **Machine Tool Task Force: an international survey to characterize the state of the art of machine tools.** Sutton, G.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 12p. (CONF-790932—1). Dep. NTIS, PC A02/MF A01.

From 7. National Science Foundation grantee's conference on production research and technology; Ithaca, NY, USA (25 Sep 1979).

The main objectives of the two-and-one-half year, multidisciplined, international survey are to characterize the state of the art of machine tool technology, identify promising future directions of this technology for the purpose of improving manufacturing productivity and reducing the cost of machined products, and to disseminate the documented findings to both the government and industry.

55351 (Y—2202) **Design of a positional reference system for ultraprecision machining.** Arnold, J.B.; Burleson, R.R.; Pardue, R.M. (Oak Ridge Y-12 Plant, TN (USA)). 25 Sep 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

The primary goal for an ultraprecision turning machine is to have the capability to position precisely the cutting points of a tool along a defined contour with respect to the part. In order to accomplish this goal, the use of a stable-positional-reference system has become apparent. Several efforts have been made by representatives of the diamond-turning community to design such a needed reference system. Efforts made at Y-12 to design the needed system are reviewed.

55352 (UCRL-Trans—11495) **Studies on the elementary process of high-speed diamond cutting of glass at machining speeds up to 100 m/sec.** Schinker, M.; Brormann, J.; Juengling, M.; Doell, W. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Freiburg im Breisgau (Germany, F.R.). Inst. fuer Festkoerpermechanik). Jun 1979. Translation of Report W2/78. 72p. Dep. NTIS, PC A04/MF A01.

Because of the large number of parameters exerting and undergoing influences during the grinding process, the influences of grinding speed (as the most important parameter), and diamond depth adjustment on crack formation and propagation in the vicinity of the contact zone between single diamond and glass surface are being studied within the proposal period during high-speed grinding at up to 100 m/sec.

55353 **Industrial applications of magnetic separation.** Liu, Y.A. (ed.). Contract ET-78-G-01-3255. New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979). 206p. (CONF-780756—).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Separate abstracts have been prepared for individual papers. (TFD)

55354 **High gradient magnetic separation: basic principles, devices, and applications.** Oberteuffer, J.A. (Sala Magnetics, Inc., Cambridge, MA). pp 3-7 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The paper presents a review of the basic principles, devices, and applications of magnetic separation, with particular emphasis on the recently developed high gradient magnetic separation (HGMS) technology.

55355 **Industrial applications of permanent magnetic separation equipment.** Carter, M.; Falconer, T.; Selvaggi, J. (Eriez Magnetics, Inc., Erie, PA). pp 8-10 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The paper describes various types of permanent magnetic separators and their applications. It presents a brief description of the field intensities generated and capacities of different permanent magnetic separation equipment.

55356 Design features of high gradient magnetic separators. Allen, J.W. (Pacific Electric Motor Co., Oakland, CA). pp 11-13 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Some of the practical design features of high gradient magnetic separators are discussed. Topics include the magnetic circuit and magnetizing coil; mechanical forces due to the magnetic field and hydraulic pressure; electrical switching; and a method to reduce the time for the magnetic field to decay.

55357 Practical aspects of high gradient magnetic separation. Price, C.R.; Abercrombie, W.F. Jr. (J.M. Huber Corp., Macon, GA). pp 14-16 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Descriptive information and operational data of high gradient magnetic separation (HGMS) applied to industrial kaolin clay processing are used to illustrate some of the practical aspects of HGMS. The efficiency of such a processing application is related to various operating parameters, including matrix packing density, matrix strand size, flow velocity, and field intensity. Also, the elements of a typical commercial application such as feed preparation, operating cycle, and matrix purging are reviewed. This information is used in support of concepts to be considered for future research efforts.

55358 General design features of industrial high gradient magnetic filters and separators. Oberteuffer, J.A.; Arvidson, B.R. (Sala Magnetics, Inc., Cambridge, MA). pp 17-21 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The commercial development and industrial application of high gradient magnetic separation began in 1969 when the first industrial cyclic, high gradient magnetic separator was designed, built and installed at the J.M. Huber Corporation by the Magnetic Engineering Associates, the predecessor company of Sala Magnetics, Inc. (SMI). Since that time, industrial-scale high gradient magnetic filters and separators are being developed and manufactured by SMI and others. The paper describes the general design features of industrial, cyclic and continuous high gradient magnetic filters and separators, emphasizing those being manufactured by SMI.

55359 Cleaning and concentration study of some mineral associates: comparison with other beneficiation processes. Gillet, G. (Ecole Nationale Superieure de Geologie Applique et de Prospection Minere, Nancy, France). pp 49-54 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Epuration and beneficiation tests on different minerals, including iron ore (Africa, Brazil, Iraq), nephelene syenite (Portugal), chromate, tungsten, manganese ores and municipal incinerator residues (glass recovery) by both dry and wet high intensity magnetic separation (HIMS) have been conducted. The experimental results are compared with those obtained from using other separation methods such as gravity concentration, selective flotation, and electrostatic separation. The problems encountered in applying HIMS to mineral beneficiation are described, and the potential advantages of HIMS compared with other beneficiation techniques are also discussed.

55360 Influence of magnetizing roasting on the magnetic separation of flint clay. Zimmels, Y.; Lefelshtil, N.; Lin, I.J. (Israel Inst. of Tech., Technion City, Israel). pp 64-72 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The magnetic properties and the corresponding separability of Israeli flint clay were studied. Using the Frantz isodynamic separator, it was shown that magnetizing roasting of the ore made it possible to obtain high-grade concentrates. Due to the roasting, the magnetic field intensity required to yield a product, with hematite content less than 1.5%, was sharply reduced. In fact, the magnetizing roasting was shown to widen the practical range of separation. Since the hematite content is low, consumption of the roasting agent, i.e., coal, is within the practical range.

55361 Magnetic field of a finite array of cylindrical ferromagnetic bars. Yaniv, I.; Zimmels, Y.; Lin, I.J. (Israel Inst. of Tech., Technion City, Israel). pp 150-153 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The distribution of forces due to a finite array of cylindrical ferromagnetic bars in a homogeneous magnetic field is calculated. Experimental and theoretical results are compared, using an ordered set of capillaries containing a paramagnetic liquid and non-magnetic particles for determining the isodirectional force lines. It is shown that the finite array provides sufficient amplication of the field and gradients to yield levitation forces suitable for scale-up. Examples of two-, three-, and four-bar arrays are solved in detail. The application of the finite arrays in magnetohydrostatic separation is discussed.

55362 Static model of high gradient magnetic separation based on forces within the fluid boundary layer. Nesset, J.E.; Finch, J.A. (McGill Univ., Montreal, Quebec). pp 188-196 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

A fundamental physical model which considers fluid shear, magnetic and gravity forces within the fluid boundary layer is used in predicting the maximum (fully loaded) condition of particle recovery on cylindrical wires. A variable susceptibility term has been incorporated into the magnetic force equations, where the particle magnetic susceptibility (x) is related to its value extrapolated to infinite field strength (x/sub ∞/), its spontaneous magnetization (σ_0) and the external field strength (H) according to the expression X = X/sub ∞/ + σ_0/H. It is shown that this variable representation of susceptibility can significantly affect the predicted amount of material captured. Saturation values of the relative accumulation radius provided by the model as a function of flow velocity and field strength are compared to recent experimental results of Friedlaender, Takayasu, Rettig and Kentzer for $Mn_3P_3O_7$. It is also shown that the fully loaded condition of a wire is not dependent on the magnetic to fluid velocity ratio, V/sub m//V/sub ∞/, if all the parameters in V/sub m/ are considered.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 54641, 55825, 55827, 55829, 55830, 55892

55363 (NBSIR—79-1609, pp 33-77) **Low cycle fatigue testing of 304LN stainless and 5083-0 aluminium alloys.** Shepic, J.A. (Martin Marietta Corp., Denver, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Fatigue data were obtained at 4°K for stainless alloy AISI 304LN (3.8 cm plate) and aluminium alloy 5083-0 (2.5 cm plate). The specimen geometry, testing apparatus, and technique used to obtain the fatigue data are described. Testing at 77° and 4°K was performed in a cryostat system prepared for low-cycle fatigue testing. Experimental test results for the two alloys are discussed and compared with other available information to obtain a comparison with alternate candidate materials.

55364 (UCRL—82397) **MAXIMSUPER: a computer program to assist in the design of multifilamentary superconducting composites.** Hoard, R.W.; Scanlan, R.M.; Hirzel, D.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jul 1979. Contract W-7405-ENG-48. 24p. (CONF-790815—6). Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

The strain degradation of critical current density has been analytically and experimentally investigated for multifilamentary superconducting composites produced in a bronze core geometry. Analytic results were obtained from a computer program (MAXIMSUPER) which predicts the stresses and strains in composites as a result of thermal and axial loading. Tensile test data for Nb_3Sn are described. It is believed that the strain dependence of the critical current found in Nb_3Sn is due to strain enhanced martensitic transformation.

55365 Applications of superconducting magnetic separation to clay and mineral processing. Clark, N.O. (English Clays Lovering Poching and Co., Ltd., Cornwell, England). pp 62-63 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The paper summarizes the practical aspects of the applications of superconducting magnetic separation to clay and mineral processing. First, the characteristics of some important separation problems, particularly those related to the English clay and mineral processing industries, are discussed. The design features of several superconducting magnetic separation systems are outlined, along with the discussion of some anticipated practical design problems and their solutions. Performance data and predicted costs for several superconducting magnetic separation devices applied to clay and mineral processing are also presented.

55366 High-speed, low-power, digital circuits using Josephson junctions. Van Duzer, T. (Univ. of California, Berkeley). pp 366-368 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

A new family of digital circuits with delay-power products orders of magnitude below semiconductor circuits is being developed. They employ Josephson junctions as switching elements and are kept at cryogenic temperatures to stay in the superconductive state. The basic concepts and the published achievements are presented.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 54262

55367 (NUREG/CR—0674) **Benchmark critical experiments on low-enriched uranium oxide systems with H/U = 0.77.** Tuck, G.; Oh, I. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). Aug 1979. Contract EY-76-C-04-3533. 111p. Dep. NTIS, PC A06/MF A01.

Ten benchmark experiments were performed at the Critical Mass Laboratory at Rockwell International's Rocky Flats Plant, Golden, Colorado, for the US Nuclear Regulatory Commission. They provide accurate criticality data for low-enriched damp uranium oxide (U_3O_8) systems. The core studied consisted of 152 mm cubical aluminum cans containing an average of 15,129 g of low-enriched (4.46% ^{235}U) uranium oxide compacted to a density of 4.68 g/cm^3 and with an H/U atomic ratio of 0.77. One hundred twenty five (125) of these cans were arranged in an ~ 770 mm cubical array. Since the oxide alone cannot be made critical in an array of this size, an enriched (~ 93% ^{235}U) metal or solution driver was used to achieve criticality. Measurements are reported for systems having the least practical reflection and for systems reflected by ~ 254-mm-thick concrete or plastic. Under the three reflection conditions, the mass of the uranium metal driver ranged from 29.87 kg to 33.54 kg for an oxide core of 1864.6 kg. For an oxide core of 1824.9 kg, the weight of the high concentration (351.2 kg U/m^3) solution driver varied from 14.07 kg to 16.14 kg, and the weight of the low concentration (86.4 kg U/m^3) solution driver from 12.4 kg to 14.0 kg.

55368 (NUREG/CR—0931) **Transportation of radioactive material in Georgia. August 1977-September 1978.** Carter, M.W.; Gasper, J.T.; Kahn, B. (Georgia Inst. of Tech., Atlanta (USA). Office of Interdisciplinary Programs). Jul 1979. 49p. NTIS.

Shipments of radioactive materials were surveyed to determine the types of materials, pattern of transportation and magnitude of activity, the extent of compliance with shipping regulations, and the radiation exposure to persons handling the materials. The transported radioactive materials were categorized as (1) radiopharmaceutical packages, (2) packages for industrial, research or educational use, (3) teletherapy and radiography sources, and (4) nuclear fuel cycle shipments. Radiopharmaceuticals constituted the most numerous shipments, but the highest curie amounts were in spent fuel elements. The transportation workers whose radiation dose rates were measured did not receive excessive increments from the radioactive materials, but practices for reducing their radiation doses can be instituted and are recommended.

55369 (UCRL—52769(Vol.2)) **Nuclear criticality experiments from 1943 to 1978: an annotated bibliography. Volume 2. Lookup tables.** Koponen, B.L.; Wilcox, T.P.; Hampel, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1979. Contract W-7405-ENG-48. 411p. Dep. NTIS, PC A18/MF A01.

55370 (UCRL—52769(Vol.3)) **Nuclear criticality experiments from 1943 to 1978: an annotated bibliography. Volume 3. Subject index.** Koponen, B.L.; Wilcox, T.P.; Hampel, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1979. Contract W-7405-ENG-48. 480p. Dep. NTIS, PC A21/MF A01.

55371 (UCRL—53769(Vol.1)) **Nuclear criticality experiments from 1943 to 1978: an annotated bibliography. Volume 1. Main listing.** Koponen, B.L.; Wilcox, T.P.; Hampel, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1979. Contract W-7405-ENG-48. 373p. Dep. NTIS, PC A16/MF A01.

The bibliography contains 1067 citations from the literature of critical and near-critical nuclear experiments. It provides an up-to-date index to reports containing useful data for many types of criticality studies. Most of the reports can provide specifications for relatively simple critical configurations necessary for validating nuclear constants and calculational techniques. The reports of more than 1143 experimentors at 38 international facilities since 1943 are cross-referenced. The collection contains the prototypes of many different designs of nuclear reactors and studies performed to insure the safe use of fissile materials in chemical processing plants, storage facilities, and transportation containers. The bibliography has three volumes. Volume 1 contains the main listing of citations with abstracts. Volume 2 is a set of indexes organized by report number, publication date, experimental facility, and author name. Volume 3 provides a subject index, concorded on the significant keyphrases derived from titles, and an index of keyterms derived from titles, and an index of keyterms extracted from titles and abstracts. The bibliography was printed by computer as a selection from a computerized system at Lawrence Livermore Laboratory contaning information and data on criticality experiments.

SHIPPING CONTAINERS

55372 (INIS-mf—4639, pp vp) **Seismic analysis of a dry spent fuel cask handling system.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

An unusual system has been developed for handling the spent fuel cask during loading of spent fuel from the storage pool to decontamination and loading of the cask onto a railroad car or truck. The unique feature of this system is that the outer surface of the cask is kept dry. However, since the system is so unusual a seismic analysis of the system was deemed necessary. The dry cask system was analyzed as a three-dimensional framework carrying a tank. It is an unusual system in that the tank is much more rigid than the supporting system. The actual analyses were carried out with the aid of SAP IV. Even though this meant that computer softwear support would not be available, it was felt the system could be modeled so that it would be satisfactorily analyzed with this program. This proved to be the case although, of course, some difficulties arose in the analysis.

55373 (PNL—2260-11) **Study of plutonium oxide leak rates from shipping containers. Quarterly progress report, April 2-June 29, 1979.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 15p. Dep. NTIS, PC A02/MF A01.

The study was initiated in October 1976. Several tasks are to be undertaken in this study which, when combined, have the end objective of defining the leak rates of plutonium dioxide powder from characterized leaks. Each task is identified and the progress during the reporting period is briefly described.

55374 (SAND—79-1404C) **Extended testing of an approved shipping container for plutonium compounds.** Yoshimura, H.R.; Pope, R.B.; Huebner, H.W.; Schulz-Forberg, B. (Sandia Labs., Albuquerque, NM (USA); Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). 1979. Contract EY-76-C-04-0789. 3p. (CONF-791103—21). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

This paper reviews the results of both the regulatory and extended testing of 18B plutonium packagings with simulated contents. The overpack is fabricated with two concentric steel tubes with axial and radial spacers. The intervening tube layers are filled with phenolic foam insulation, which provides both thermal and impact resistance. The T-shaped lid is of foamed construction and is designed to swage into the upper part of the inner tube assembly when stressed by a severe mechanical impact, thus providing an additional containment barrier. Results show that 18B can withstand long-duration fires and high velocity impacts. Ring stiffener modifications did not survive the high speed impact test in NUREG 0360.

MINING AND DRILLING EQUIPMENT AND FACILITIES

55375 Well cementing method and apparatus. Duke, J.A. US Patent 4,164,980. 21 Aug 1979. Filed date 2 Aug 1978. 8p.

A new and improved apparatus and method for cementing casings in wells that is particularly advantageous for use in subsea wells. The cementing plug apparatus contains the cementing plugs which are released by a predetermined manipulation of the support string for the apparatus. Inadvertent or premature release of the cementing plug is prevented by a telescoping tubular stinger member which protects the cementing plugs from circulation flow.

55376 Movable working platform for use in racking drill pipe. Jenkins, C. (to Lee C. Moore Corporation). US Patent 4,163,625. 7 Aug 1979. Filed date 10 Feb 1978. 4p.

Suspension members flexibly connected to a carriage and to an overhead support above the racking platform of an oil well mast or derrick support the carriage, which is provided with a floor to support a derrick man therein. The lower end of the suspension means can be swung back and forth parallel to the side of the mast or derrick and also at right angles to it to thereby move the carriage in the same directions, the carriage being provided with a lateral seat for receiving the upper end portion of a pipe and moving it with the carriage into another position.

LASERS

REFER ALSO TO CITATION(S) 55855

55377 (COO—4275-8) **Metal vapor excimer laser. Quarterly progress report, February 1, 1978-April 30, 1979.** Mandl, A.; Klimek, D. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Jun 1979. Contract ES-77-C-02-4275. 24p. Dep. NTIS, PC A02/MF A01.

A new alignment procedure has resulted in Febetron preionized current pulses up to 400 A (500 kV, 30 ns) with a consequent increase in the discharge current to ~ 100 A/cm² at 10 to 20 kV. Under these conditions spectra for Cd/Hg/Ne mixtures have indicated large HgCd* continuum emission with densities ~ 3 x 10^{16} cm^{-3} and a lifetime ~ 3 μs. A major technology problem still remaining which has considerably slowed the research is the unreliability of the quartz to metal seals at high temperature (550°C). Work on this problem is described. The apparatus is presently being set up to make gain/absorption measurements over the HgCd* emission band.

55378 (COO—4308-1) **Laser materials: July 1, 1977-July 31, 1978.** Folweiler, R.C. (Sanders Associates, Inc., Nashua, NH (USA)). 8 Aug 1979. Contract ES-77-C-02-4308. 74p. Dep. NTIS, PC A04/MF A01.

Fluoride materials display specific properties applicable for use as active and passive optical elements for advanced laser programs. Generally, these materials exhibit low values of n_2 and high ultraviolet transmission. Nd:YLF is a very promising laser fusion oscillator element operating in conjunction with phosphate and fluoroberyllate systems. New materials possessing high concentrations of terbium and cerium - KTb_3F_{10}, $RbTb_3F_{10}$ and potassium cerium compounds, display high magneto-optical rotatory power, high Verdet's constant, for use as Faraday rotators. Nd:YLF, operating at 1.047 μm or 1.053 μm has been identified as the most promising oscillator material for phosphate and fluoroberyllate systems. The new materials investigation included crystal growth and phase study of KTb_3F_{10}. KTb_3F_{10} displays one of the highest figures of merit of any known material. Preliminary growth studies of other potential rotator materials included the RbF-Tb_3F_{10} and the KF-CeF_3 systems. Compounds of both systems are expected to display high Verdet's constants.

55379 (DOE/TIC—10163) **Short wavelength lasers for fusion. Final report, April 1, 1978-March 31, 1979.** Djeu, N.; Wexler, B. (Naval Research Lab., Washington, DC (USA)). 1979. Contract ES-77-A-01-6021. 37p. Dep. NTIS, PC A03/MF A01.

Two approaches to laser fusion drivers are examined: (1) an optically pumped Hg ($6^3P_0 \rightarrow 6^1S$) energy storage system; (2) metal vapor Raman compression. The feasibility of the first method was investigated by measuring the Hg stimulated emission cross section, which implied a saturation photon fluence in excess of the damage limit on existing window materials. The possibility of obtaining peak power magnification through stimulated Raman scattering was investigated by studying metal vapors as the appropriate Raman medium. The experiments indicate that a XeCl laser in conjunction with Pb vapor constitutes the most promising pump-compressor combination. Compression in excess of 6.7, with photon efficiencies of 42%, has been observed.

55380 (LA—7898-MS) **Feasibility of an impulsively driven gamma-ray laser.** Solem, J.C. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

The feasibility of a gamma-ray laser initiated by the neutron flux from a nuclear explosive and the possibility of a research program that would culminate in the Nevada test of such a device are discussed. It is shown that such a device is plausible within our understanding of Moessbauer technology and the kinetics of superradiant systems. Its scientific application as well as its implications for future weaponry are described.

55381 (SAND—79-1659) **λ-3, Sandia's 100-J HF laser system.** Klein, R.A. (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 46p. Dep. NTIS, PC A03/MF A01.

Sandia's λ-geometry intermediate electron-beam-initiated HF amplifier is described in sufficient detail such that a similar system could be designed, constructed and characterized. Items included are the design of the laser cell, magnetic field design and measurements, electron-beam calorimetry, and typical laser results.

55382 (SLAC-PUB—2371) **Variable parameter free electron laser.** Morton, P.L. (Stanford Linear Accelerator Center, CA (USA)). Aug 1979. Contract EY-76-C-03-0515. 14p. (CONF-790853—1). Dep. NTIS, PC A02/MF A01.

From ONR workshop on electron generators of coherent radiation; Telluride, CO, USA (13 Aug 1979).

The recent successful operation of the free electron laser by the group at Stanford and the availability of high power electron beams has stimulated a great deal of interest in the use of the free electron laser (FEL) to produce a high power tunable laser beam. The paper treats the FEL in a manner which has been used by accelerator physicists to treat the acceleration of charged particles with radio frequency accelerating systems. This allows the ideas that have been developed for the acceleration of charged particles to be used in the design of the wiggler magnet used for the FEL. The emphasis of the paper is mainly tutorial so that the derivation of the equations are presented in a physically intuitive fashion rather than in a strictly rigorous manner. This type of treatment displays in a rather graphic way how the variation of the magnetic wiggler field and wave length affects the coupling of the electron energy to the optical laser beam. We will find that by proper variation of the wiggler parameters, it is possible to obtain a tremendous improvement in the performance of a variable parameter wiggler over the constant parameter wiggler.

55383 **New HF laser pumped molecular lasers in the middle infrared.** Bushnell, A.H.; Jones, C.R.; Buchwald, M.I.; Gundersen, M. (Tex Tech Univ, Lubbock). *IEEE J. Quant. Electron.;* **QE-15**: No. 4, 208-209(Apr 1979).

Simulated emission has been observed in five molecules optically pumped by a pulsed HF laser. Emission was observed in $^{15}N_2O$, $^{14}N^{15}NO$, and $^{15}N^{14}NO$ at 4.6 μm, HCOOH at 5.7 μm, and in $^{13}CS_2$ at 6.9 μm. Lasing pulse shapes and delays after the pump pulse were measured. Lasing due to rotational relaxation induced by collisions with He was observed in ;sup 15;$N^{14}NO$.

55384 **Tunable lasers and applications.** Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976). 414p. (CONF-760613—).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

This conference dealt with the technology of tunable lasers from the vacuum ultraviolet to the far infrared and their application in the areas of photochemistry, chemical kinetics, isotope separation, atmospheric photochemistry and environmental studies, photobiology, and spectroscopy.

55385 **Scalable tunable ir lasers.** Mooradian, A. (Massachusetts Inst. of Tech., Lexington). pp 60-69 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Some of the practical operating characteristics and limitations of tunable infrared sources including semiconductor lasers, spin-flip Raman lasers, and nonlinear mixers are discussed. In particular, those characteristics which are important for applications in high resolution spectroscopy and laser induced photochemistry and diagnostics are discussed. These fields are still in an early stage of their development with a substantial amount of work yet to be done in the laboratory using small to moderately powered laser systems. Industrial photochemical processes will require efficient and high average power laser sources at a specific frequency once a specific technique has been demonstrated in the laboratory. A significant impact in the above areas will occur when tunable sources that are simple to operate, inexpensive, and cover a broad wavelength range with pulsed and moderately high average (several watts) power output and high resolution capability are made available to the research community. Substantial progress in this direction is expected to occur in the next few years.

55386 **Parametric oscillators.** Byer, R.L. (Stanford Univ., CA). pp 70-80 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Parametric oscillators have recently gained wider acceptance as sources of visible and infrared tunable coherent radiation. Their acceptance has come about due to improvements in the laser pump sources and in the nonlinear crystals which have led to wider tuning ranges at substantially higher peak and average powers than previously available. Since the operation of the first parametric oscillator in $LiNbO_3$, parametric oscillators have been demonstrated in KDP, ADP, and related isomorphs, HIO_3 and $LiIO_3$, and proustite and CdSe. The operation characteristics of the devices is well under-

stood. A Nd:YAG pumped, computer controlled, $LiNbO_3$ parametric oscillator is described. The oscillator is now well engineered and offers operating characteristics expected of a tunable coherent spectrometer source.

55387 Efficient high-power 8.62 μm infrared radiation source for uranium isotope separation in UF_6. Aggarwal, R.L.; Lee, N.; Lax, B. (Massachusetts Inst. of Tech., Cambridge). pp 96-99 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Various aspects of the generation of infrared radiation at 8.62 μm by noncollinear phase-matched four photon mixing of CO_2 laser beams in germanium at room temperature, as a potential infrared source for the uranium laser isotope separation in UF_6 are examined.

55388 Control techniques for cw dye lasers. Hall, J.L.; Lee, S.A. (National Bureau of Standards, Boulder, CO). pp 361-366 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

A few problems confronting users of cw dye lasers are listed. a dye laser is described which coarse tunes smoothly without skipping spectrally, has a 50 kHz spectral width, is single mode tuneable over 2 GHz, at 5900 A gives 120 mW output of almost gas laser beam quality from 1 W of 5145 A pump light, has intensity stabilization to $\simeq 10^{-4}$, and has sufficient optical isolation to allow 100% mode matched retroreflection without noticeable effect.

55389 Optically pumped gas lasers. Kildal, H.; Deutsch, T.F. (Massachusetts Inst. of Tech., Lexington, MA). pp 367-377 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Recent advances in techniques for remote probing of trace gases in the atmosphere, in laser-induced photochemistry, and in laser isotope separation have created a need for new infrared laser sources at frequencies that match molecular vibrational absorption bands. The work on optically pumped infrared lasers has been motivated primarily by the needs of the Los Alamos Scientific Laboratory UF_6 isotope separation program which requires lasers at 7.74, 8.62, 12.1, or 15.9 μm. It is demonstrated that optical pumping combined with vibrational energy transfer is a general technique for producing new infrared lasers. Numerous laser lines in the 6 to 12 μm region with output energies up to 13 mJ and efficiencies ranging from 0.1 to over 30% have been obtained.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 55000, 55142, 55349

55390 (CONF-790615—26) **Finite element formulation for fluid-structure interaction in three-dimensional space.** Kulak, R.F. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 31p. Dep. NTIS, PC A03/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

A development is presented for a three-dimension hexahedral hydrodynamic finite-element. Using trilinear shape functions and assuming a constant pressure field in each element, simple relations were obtained for internal nodal forces. Because the formulation was based upon a rate approach it was applicable to problems involving large displacements. This element was incorporated into an existing plate-shell finite element code. Diagonal mass matrices were used and the resulting discrete equations of motion were solved using explicit temporal integrator. Results for several problems were presented which compare numerical predictions to closed form analytical solutions. In addition, the fluid-structure interaction problem of a fluid-filled, cylindrical vessel containing internal cylinders was studied. The internal cylinders were cantilever supported from the top cover of the vessel and were periodically located circumferentially at a fixed radius. A pressurized cylindrical cavity located at the bottom of the vessel at its centerline provided the loading.

55391 (COO—4649-6) **Bibliography on augmentation of convective heat and mass transfer.** Bergles, A.E.; Webb, R.L.; Junkhan, G.H.; Jensen, M.K. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). May 1979. Contract ET-78-S-02-4649. 520p. (ISU-ERI-AMES—79206; HTL—19). Dep. NTIS, PC A22/MF A01.

Heat transfer augmentation has developed into a major specialty area in heat transfer research and development. A bibliography of world literature on augmentation is presented. The literature is classified into passive augmentation techniques, which require no external power, and active techniques, which do require external power. The fourteen techniques are grouped in terms of their application to the various modes of heat transfer. Mass transfer is included for completeness. Key words are included with each citation for technique/mode identification. The total number of publications cited is 1,967, including 75 surveys of various techniques and 42 papers on performance evaluation of passive techniques. Patents are not included as they will be the subject of a future topical report.

55392 (INIS-mf—4638, pp vp) **Pressure fluctuations induced by fluid flow in singular points of industrial circuits.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Flow singularities (enlargements, bards, valves, tees, ...) generate in the circuits of industrial plants wall pressure fluctuations which are the main cause of vibration. A methodical study of the most current singularities has been performed at C.E.A./D.E.M.T. On one hand, a theory of noise generation by unsteady flow in internal acoustics has been developed. This theory uses the basic ideas initiated by LIGHTILL. As a result it is shown that the plane wave propagation is a valid assumption and that a singularity can be acoustically modelled by a pressure and a mass-flow-rate discontinuities. Both are random functions of time, the spectra of which are determined from the local fluctuations characteristics. On the other hand, characteristics of several singularities have been measured, e.g., intercorrelation spectra of local pressure fluctuations. Autocorrelation spectra of associated acoustical sources (the measure of the acoustical pressures in the experimental circuit) are interpreted by using the D.E.M.T. computer code VIBRAPHONE which gives the acoustical response of a complex circuit. Experimental atmospheric air and water loops have been used. The Reynolds number has been changed between about 10^5 and 10^6, the Mach number between about 0.01 and 0.5. Simple laws with dimensionless parameters are formulated and can be used for the estimation of the acoustical and mechanical vibration level of a circuit with given singularities.

55393 (INIS-mf—4638, pp vp) **Stability of one-step methods in transient nonlinear heat conduction.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The purpose of the present work is to ascertain practical stability conditions for one-step methods commonly used in transient nonlinear heat conduction analyses. The class of problems considered is governed by a temporally continuous, spatially discrete system involving the capacity matrix C, conductivity matrix K, heat supply vector, temperature vector and time differentiation. In the linear case, in which K and C are constant, the stability behavior of one-step methods is well known. But in this paper the concepts of stability, appropriate to the nonlinear problem, are thoroughly discussed. They, of course, reduce to the usual stability criterion for the linear, constant coefficient case. However, for nonlinear problems there are differences and these ideas are of key importance in obtaining practical stability conditions. Of particular importance is a recent result which indicates that, in a sense, the trapezoidal and midpoint families are quivalent. Thus, stability results for one family may be translated into a result for the other. The main results obtained are summarized as follows. The stability behavior of the explicit Euler method in the nonlinear regime is analogous to that for linear problems. In particular, an a priori step size restriction may be determined for each time step. The precise time step restriction on implicit conditionally stable members of the trapezoidal and midpoint families is shown not to be determinable a priori. Of considerable practical significance, unconditionally stable members of the trapezoidal and midpoint families are identified.

55394 (INIS-mf—4638, pp vp) **High intensity heat pulse problem.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The case of a pulse of high intensity electromagnetic radiation of nuclear origin with a thermal flux level of the order of 10^7 watts/cm^2 or greater may generate the surface temperature and its gradient significantly greater than the classical models. The plasma torch is another example for presence of large heat fluxes. Classical steady and unsteady heat conduction problems are well known. All these problems can be special cases of a more generalized heat diffusion model where first and second order derivatives in both two-dimensional space and time appear. The generalized equation may be hyperbolic (large heat fluxes), elliptic (independent of time), or parabolic (classical Fourier) depending upon the parameters chosen. Since the mathematical characteristics are different for each, it is common to utilize specialized techniques for each class of problems. Recently Yalamanchili showed that the finite-element and finite-difference belong to the class of methods of weighted-residuals and pointed out that the finite-element method is inferior to some other possible variations of finite-difference method in accuracy and non-oscillation characteristics. Therefore, the explicit finite-difference scheme is utilized for the generalized transient two-dimensional diffusion equation. A transient one-dimensional example with step

change in temperature on one side and insulated on the other surfaceis computed.

55395 Propagation of boiling boundary phase-change fronts in moving fluids. Kroeger, P.G. (Brookhaven National Lab., Upton, NY). *J. Fluids Eng.;* **101**: No. 2, 270-275(Jun 1979).

The transient propagation of boiling boundary phase-change fronts during the depressurization of a subcooled liquid has been investigated for the case of thermal equilibrium without friction or heat addition, using wave diagram solutions. Various modes of phase-change front propagations have been identified and it is shown that certain ranges of propagation speeds are impossible, while others require the simultaneous formation of shocks. Qualitative and quantitative results are given for two specific cases of interest.

55396 Heat tranfer during piston compression including side wall and convection effects. Greif, R.; Namba, T.; Nikanham, M. (Univ. of California, Berkeley). *Int. J. Heat Mass Transfer;* **22**: No. 6, 901-907(Jun 1979).

The unsteady heat flux from a non-reacting gas to the sidewalls of a channel has been determined during the piston compression of a single stroke. For small changes in the wall temperature, the heat flux may be determined solely from the variation of the temperature outside the boundary layer or, alternatively, from the piston trajectory. Results for the heat-transfer coefficient are also presented and exhibit a non-monotonic variation with respect to time.

55397 Observation of particle trajectories near a magnetized fiber. Treat, R.P. (Dept. of Energy, Morgantown, WV); Lawson, W.F.; Johnson, J.L. pp 159-165 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The motions of 20 to 30 μm paramagnetic particles have been observed in the neighborhood of a 250μm ferromagnetic fiber. The particles are entrained in nitrogen flowing down over a horizontal fiber. The particles and fiber are magnetized by a vertical magnetic field of strength up to 0.73 Tesla. The free stream velocities range from nearly zero to 1 m/sec. A Fastax movie camera is used to record the positions of the particles as they pass by or collide with the fiber. The particle trajectories thus observed determine the collision cross-section as a function of field strength and free stream velocity. Cross-sections of over 5 fiber diameters are observed. The cross-sections and the trajectories are compared and agree with the Newtonian theory of the particle motion. The theory assumes potential flow over the fiber and accounts for the magnetic, viscous and gravitational forces and particle inertia, all of these being significant in the range of conditions considered. The observed trajectories show details of the motion which are clear manifestations of particle inertia. The sharp particle shadows cast by the isolated fiber are a striking feature of the trajectory pattern. Such shadows should be the source of an interference effect in multiple-fiber filters.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 54051, 55225

55398 (ANL/MSD—79-5) **Nondestructive evaluation techniques for high-temperature ceramic components. Seventh quarterly report, April-June 1979.** (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 24p. Dep. NTIS, PC A02/MF A01.

SiC samples with various microstructures were examined by through-transmission acoustic microscopy. The microstructures were ranked with respect to ease of inspection. Some preliminary results were presented on the use of a transducer and acoustic mirror for bore-side ultrasonic inspections of SiC tubing. The technique of photoacoustic microscopy is discussed. A simple test was run to illustrate the principles involved in this technique.

55399 (LA-UR—79-1902) **Application of Pade approximants to elastic wave scattering.** Gubernatis, J.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790757—1). Dep. NTIS, PC A02/MF A01.

From ARPA/AF review of progress in quantitative NDE; La Jolla, CA, USA (8 Jul 1979).

Several Pade methods were used to try to accelerate the convergence of partial wave sums for scattering amplitudes. A specific test problem of longitudinal-to-longitudinal scattering from a spherical void was studied in detail. Results for this test case and the behavior of partial wave amplitudes for general cases are presented and discussed. 16 references.

55400 (SAND—79-1217C) **Assessment of positron annihilation as a potential non-destructive examination technique.** Jones, W.B.; Van Den Avyle, J.A.; Gauster, W.B.; Wampler, W.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-C-04-0789. 5p. (CONF-790757—2). Dep. NTIS, PC A02/MF A01.

From ARPA/AF review of progress in quantitative NDE; La Jolla, CA, USA (8 Jul 1979).

The positron annihilation technique can provide a sensitive measure of defect density in metals. In this program the technique has been used to monitor defects generated during plastic deformation by cold work or fatigue cycling. The primary goals have been: (1) to assess the degree of sensitivity of the technique; (2) to correlate positron annihilation readings with observed microstructural changes to better understand the physical basis for these readings; and (3) to determine correlations between positron annihilation measurements and number of fatigue cycles. Examination of fatigued samples by transmission electron microscopy indicates some correlation between dislocation density and positron annihilation lineshape parameter (determined by the Doppler broadening technique). However, annealing studies of deformed samples indicate that positron annihilation response in 316 stainless steel is sensitive primarily to excess vacancies generated during the deformation and is less sensitive to dislocation density. Data on deformed nickel show sensitivity to both vacancies and dislocations. In general, lineshape parameter values tend to achieve a constant level at approximately 10% of fatigue life.

55401 (UCRL—81030) **Acoustic emission generated in unflawed 7075-T651 aluminum under uniform biaxial loading.** Hamstad, M.A.; Patterson, R.G.; Mukherjee, A.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Dec 1978. Contract W-7405-ENG-48. 14p. (CONF-791101—3). Dep. NTIS, PC A02/MF A01.

From 9. world conference on nondestructive testing; Melbourne, Australia (18 Nov 1979).

A tubular specimen for acoustic emission testing of unflawed metals under uniaxial or biaxial loading was designed. The test technique and specimen design using 7075-T651 aluminium were evaluated. Biaxial result differed significantly from uniaxial results.

55402 Ultrasonic inspection using the pitch-catch technique. Moyer, M.W.; Donsbach, D.L. (Oak Ridge Y-12 Plant, TN). *Mater. Eval.;* **37**: No. 5, 51-54(Apr 1979).

The pitch-catch technique is useful in solving several problems which cannot be solved using conventional ultrasonic techniques. These include the inspection of multiple layer bonds, the measurement of weld penetration exceeding 30% of the wall thickness in a 2 to 3 mm thick weld, and the measurement of layer thickness in a multiple layer structure. In addition, the use of the pitch-catch technique coupled with a normal inspection has shown promising results in the development of a technique to measure wall thickness from one side which is independent of velocity variations in the material. Basically, the pitch-catch technique uses a geometrical configuration of two transducers to optimize the reflections from interfaces of interest and minimize unwanted reflections. Design considerations and results are given.

55403 Digital image analysis applied to industrial nondestructive evaluation and automated parts assembly. Janney, D.H.; Kruger, R.P. (Los Alamos Scientific Lab., NM). *Int. Adv. Nondestr. Test.;* **6**: 39-93(1979).

Many ideas of image enhancement and analysis are relevant to the needs of the nondestructive testing engineer. These ideas not only aid the engineer in the performance of his current responsibilities, they also open to him new areas of industrial development and automation which are logical extensions of classical testing problems. The paper begins with a tutorial on the fundamentals of computerized image enhancement as applied to nondestructive testing, then progresses through pattern recognition and automated inspection to automated, or robotic, assembly procedures. It is believed that such procedures are cost-effective in many instances, and are but the logical extension of those techniques now commonly used, but often limited to analysis of data from quality-assurance images. Many references are given in order to help the reader who wishes to pursue a given idea further.

SAFETY ENGINEERING

REFER ALSO TO CITATION(S) 54244

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 54626, 55366

55404 (LA—7956-M) **E-2 electronic fabrication standards of workmanship.** Morgan, R. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 51p. Dep. NTIS, PC A04/MF A01.

This standard and workmanship manual presents a variety of the requirements used by the E-Divison electronic fabrication facility. Emphasis is placed upon the results expected rather than upon methods to be used for fabrication.

55405 (SAND—79-0714C) **Radiation-hardened bulk CMOS technology.** Dawes, W.R. Jr.; Habing, D.H. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-791040—1). Dep. NTIS, PC A02/MF A01.

From 2. computers in aerospace conference; Los Angeles, CA, USA (22 Oct 1979).

The evolutionary development of a radiation-hardened bulk CMOS technology is reviewed. The metal gate hardened CMOS status is summarized, including both radiation and reliability data. The development of a radiation-hardened bulk silicon gate process which was successfully implemented to a commercial microprocessor family and applied to a new, radiation-hardened, LSI standard cell family is also discussed. The cell family is reviewed and preliminary characterization data is presented. Finally, a brief comparison of the various radiation-hardened technologies with regard to performance, reliability, and availability is made.

55406 (SAND—79-7046) **Backscatter response of snow covered roads and roadside surfaces. RSL technical report 377-2.** Ulaby, F.T.; Stiles, W.H. (Kansas Univ. Center for Research, Inc., Lawrence (USA). Remote Sensing Lab.). Aug 1979. Contract EY-76-C-04-0789. 68p. Dep. NTIS, PC A04/MF A01.

The angular response of the backscatter coefficient σ^0 was measured with Microwave Action Spectrometer (MAS 8-18/35) for snow covered targets. Snow under varying conditions on compacted dirt, short grass, asphalt and concrete surfaces were observed. The measurements were made the angular range 0^0 (nadir) to 80^0, for three linear polarizations (HH, HV and VV) and at three frequencies (8.6, 17.0 and 35.6 GHz). Comparison of the data on snow covered targets is made with previous measurements in the absence of snow. The general effect of wet or dry snow was observed to be a decrease in the total response dynamic range and therefore an increased difficulty in target discrimination.

55407 **Computer-aided design of active R ladders.** Lee, K.L. (Univ. of California, Davis); Soderstrand, M.A. pp 611-616 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

Active R ladders are simulations of terminated passive reactance two-ports made with operational amplifiers and resistors without inductors or external capacitors. Normally, these filters are designed by direct replacement of the passive circuit with an active R simulation derived with an integrator model for the operational amplifier. Due to the use of this simplified integrator model, certain aspects of the operational amplifier, such as dc offset, noise, and higher-order poles, are not taken into account. However, by inserting a computer simulation step into the design procedure, stability can be guaranteed, dc offsets can be eliminated, temperature variations can be compensated, and noise problems can be addressed. 8 figures, 1 table.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 54275

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 54617, 55128, 55129, 55130

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 54407, 55375

55408 **Implosion analysis of concrete cylindrical vessels.** Suzuki, H.; Chen, W.F.; Chang, T.Y. (Univ of Akron, Ohio). *J. Pressure Vessel Technol.;* **101**: No. 1, 98-102(Feb 1979).

Concrete constitutive relations which can simulate the overall material behavior up to and including its ultimate state under general triaxial loading conditions have been developed. The proposed constitutive relations include: 1) plastic deformation considering the effect of hydrostatic pressure, 2) a dual criterion predicting the fracture of concrete in terms of either stresses or strains, and 3) post-fracture behavior of concrete. Corresponding to the constitutive model, a finite element analysis procedure has also been utilized. Based on the proposed model, implosion pressures and load-deformation responses of several concrete vessels were obtained. The numerical results correlate quite well with the experimental data when the dual criterion was used. 13 refs.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 54620, 55353

55409 **Particulate emission control by high gradient magnetic separation.** Gooding, C.H. (Research Triangle Inst., Research Triangle Park, NC); Sigmon, T.W.; Monteith, L.K.; Drehmel, D.C. pp 42-46 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

A theoretical and experimental investigation has been conducted to assess the potential use of high gradient magnetic separation (HGMS) as a method of collecting particulate matter from industrial stack gases. Preliminary calculations and bench-scale experiments were first utilized to demonstrate the ability of HGMS to collect fine gas-borne particles and to provide guidelines for the design of a pilot-scale unit. An experimental program was then conducted in the pilot plant using dispersed dusts obtained from two steel industry processes. A theoretical particle trajectory model was used to analyze the results and to study the effects of particle characteristics and system operating parameters. The results indicate that high-efficiency collection of fine particles can be achieved with operating conditions that project to competitive full-scale capital costs and power requirements. A mobile pilot-plant is now being developed to conduct the next phase of testing at a Pennsylvania steel mill in mid-1979.

55410 **Preliminary results on particle trajectories in a lattice of magnetized fibers in high gradient magnetic separation.** Simons, W.H. (West Virginia Univ., Morgantown); Treat, R.P. pp 145-149 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Preliminary results on trajectories of paramagnetic particles in regular infinite rectangular lattices of parallel fibers are presented. The mathematical model for this analysis accounts for the collective magnetic and fluid effects of all the fibers in the lattice. The fluid disturbance caused by the fibers is approximated by the potential flow. The viscous force on the particles is taken to be the Stokes force, and diffusion and particle inertia are assumed to be negligible. Particle capture cross sections for a fiber in a lattice are found from the trajectories. It is seen that channels are formed, which allow particles to pass through the filter.

55411 **Video recording of particle trajectories and buildup of single wires in high gradient magnetic separation.** Friedlaender, F.J.; Takayasu, M. (Purdue Univ., West Lafayette, IN). pp 154-158 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Buildup profiles of ferromagnetic iron oxide particles (Fe_3O_4) are qualitatively compared to those of paramagnetic particles ($Mn_2P_2O_7$). Particles of Fe_3O_4 are generally collected in long chains. The buildup is not as homogeneous along the axis of a collection wire as that of paramagnetic particles. Preliminary experiments are also carried out to investigate the buildup of a mixed diamagnetic/paramagnetic particle system, and the effect of the pH of the slurry on the collection of Fe_3O_4 particles is observed. Washing off of particles collected on a single wire is briefly discussed.

55412 **Steady-state solution of filter equations of high gradient magnetic separation.** Uchiyama, S. (Nagoya Univ., Japan); Kurinobu, S. pp 166-168 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

In order to know the time-dependent performance of magnetic filter in high gradient magnetic separation (HGMS), an approach to utilize the filter equation was proposed and the equation was solved either numerically or analytically for the case of very strong interaction. In this paper, we would like to show that the equation has solutions with analytical form if the steady-state condition is fulfilled. The solution may be applied for the analysis of breakthrough curves of a magnetic filter provided that the particles are strongly magnetic, more exactly, if $\alpha_0 L >> 1$, where α_0 and L are

the initial absorption coefficient and the length of the magnetic filter, respectively.

55413 Analytical theory of magnetic particle capture process and capture radius in high gradient magnetic separation. Uchiyama, S.; Hayashi, K. (Nagoya Univ., Japan). pp 169-173 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

Available theories of high gradient magnetic separation (HGMS) have utilized mainly the computer simulation in calculating particle trajectory and capture radius. In this paper, we present analytical expressions which enable us to calculate very easily the particle trajectory and capture radius with the aid of a table electronic calculator. The expressions include the cases of potential and creeping flow approximations to the liquid flow field. This analytical theory can be easily extended to the case where the particle build-up is appreciable. The particle trajectories and the capture radii for the case of multiple wires of linear regular array are also presented.

55414 Inversion of the breakthrough curve of a high gradient magnetic filter: theory and experiment. Collan, H.K.; Jantunen, J.; Kokkala, M.; Ritvos, A. (Helsinki Univ. of Technology, Finland). pp 175-187 of Industrial applications of magnetic separation. Liu, Y.A. (ed.). New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).

From Conference on industrial application of magnetic separation; Rindge, NH, USA (30 Jul 1978).

The deduction of filter matrix properties from the measured filter breakthrough curve is of fundamental importance for the development of efficient and economical high gradient magnetic filters. In this paper we first calculate the breakthrough curve for a matrix with known properties. We then show that this procedure can be inverted to yield the filtration characteristics of the matrix. The theory is applied to analyze test filtrations with several types of filter matrices. The results show that a simple mathematical model is sufficient for the systematic and quantitative comparison of various matrix materials. In addition to the matrix evaluation, the method used gives information about the actual process of particle capture on the filter fibers.

55415 Particle size distribution in operating foundry cupolas. Davis, J.W. (Pa State Univ, University Park). *Proc. Air Pollut. Control Assoc.;* **5**: 1-27(1978).

A study of cupola emissions was undertaken in conjunction with a project sponsored by the Department of Energy. In this study over 50 particle size distributions were obtained at eight different production foundries over a range of operating parameters. An Anderson In-Stack Impactor was used to make the measurements. An experimental design utilizing an analysis of variance routine made possible the study of the operating parameters associated with particle emissions. These were blast rate, iron-coke ratio, blast temperature, and melt rate. 16 refs.

POWER CYCLES

55416 (UCRL-Trans—1573) **Ecological consequences of the generation of useful energy from primary fossil energy and some proposed possibilities for solving the problem.** Kirchhoff, J. May 1979. Translated from an unpublished German paper, 1979. 35p. Dep. NTIS, PC A03/MF A01.

The following topics are discussed: (1) the Banks Engine, a machine suitable for producing mechanical energy from low temperature heat, such as solar heat; (2) the exact solution or Russian roulette as a basis for the determination of the efficiency of machines using natural effects; (3) the first and second laws of thermodynamics; and (4) requirements for new heat-power machines.

RANKINE

REFER ALSO TO CITATION(S) 54614

PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 55842

DESIGN, DEVELOPMENT, AND OPERATION

55417 (FERMILAB—79/7) **Fermilab report.** (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1979. Contract EY-76-C-02-3000. 26p. Dep. NTIS, PC A03/MF A01.

The annual extended meeting of the Physics Advisory Committee was held from June 16 to June 22. A large amount of time was devoted to discussion of issues relating to the forthcoming Tevatron era and to evaluation of the physics record of the Fermilab experimental program. Three proposed experiments and three requests for extensions were approved. Other sections in this issue include Notes and Announcements, Summary of Operations, Monthly Operations History, Beam Utilization by Experimental Activity, Facility Utilization Summary, Manuscripts and Notes Prepared, and Dates to Remember. 6 figures. (RWR)

55418 (IFVE-M—24(Pt.2), pp 64-69) **Polarized proton acceleration at the zero gradient synchrotron.** Martin, R.L. (Argonne National Lab., IL (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

A new developments of the Argonne National Laboratory zero gradient synchrotron polarized proton beam are reported. New intensity record (4.3×10^{10} proton/pulse) was established. Midplane correction pulses were applied on 19 imperfection resonances to achieve a polarization of 69% at 11.75 GeV/c. The pulsing pole face winding currents were introduced to correct depolarization effects. The operating efficiency reached the value of 95.7%. The synchrotron operation proved to be reliable.

55419 (LA—7903-PR) **Medium-energy physics program. Progress report, August 1-October 31, 1978.** van Dyck, O.B.; Dunn, E.D. (comps.). (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 83p. Dep. NTIS, PC A05/MF A01.

During this quarter, Cycle 21 encompassed 44.5 days of accelerator operation for experiments and 25 days for beam tuning and facility development studies. The H^+ beam intensity during research shifts was 360 μA/sub a/ at 6% duty factor; beam availability was 90%. Several modifications were made thoughout the machine to conserve energy. Design work is underway on modifications to permit dual-energy operation (variable-energy H^- operation, with time-shared, full-energy H^+). The VAX-11/780 computer was delivered in July and is now on-line. Tumor treatments with π- are now approaching dose tolerance, with a number of complete tumor regressions observed; 67 patients have received treatment. Forty-nine experiments received beam this quarter. A total of 132 experiments have now been completed at LAMPF. 13 items containing significant data are indexed separately. 42 figures, 13 tables.

55420 Summary of the second international conference on electrostatic accelerator technology. Wegner, H.E. (Brookhaven National Lab., Upton, NY (USA)). *Rev. Phys. Appl.;* **12**: No. 10, 1587-1594(Oct 1977).

This summary reviews the information and new results presented at this Conference and compares the present overall performance of the major electrostatic accelerators to that at the time of the last Conference, four years ago. The advances in electrostatic accelerator technology in the four year period are discussed in terms of accelerator tube improvements, electrostatic charging system improvements, ion source developments, and other aspects of machine design and operation.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 55450, 55645

55421 (ANL—79-41, pp 141-146) **Summary of the working group on high current transport and final focus lenses.** Garren, A.A. (Lawrence Berkeley Lab., CA). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Transverse instabilities of intense beams in periodic transport lines are reviewed. Chromatic aberrations in the final beam transport lines and geometric aberrations due to quadrupole fringe fields are discussed and corrections to reduce them are evaluated. The implications for four reference designs are evaluated by comparing the tune depression, momentum spread, and emittance.

55422 (ANL—79-41, pp 147-170) **Workshop on plasma effects.** Thompson, W.B. (Univ. of California, San Diego). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The major problem studied here has been the propagation of the high current, high energy, but unguided ion beam across the 5 to 10 m radius target chamber onto the 1 mm target. If the target chamber pressure is less than 10^{-5} torr, number density $n < 10^{12}$ cm^{-3}, the beam propagates as though in vacuum, and in a low enough charge state even an unneutralized beam should reach the target ballistically. At pressures $> 10^{-4}$ torr, the high value of the cross section for ionization of the beam particles $\sigma = 10^{-16}$ to 10^{-17} means that the beam charge state grows while the background gas is

ionized. As a result the beam is charge neutralized and to a large extent, current neutralized; however, a two stream instability is excited and the electric fields produced seem great enough to deflect the beam by about 1 mm, enough to miss the target.

55423 (ANL—79-41, pp 287-289) **Factors causing large transverse emittance increase in linacs using a high-brightness ion source.** Staples, J. (Lawrence Berkeley Lab., CA). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The dilution of the transverse beam emittance in linacs with very high brightness ion sources is investigated using a single coupling argument and a simulation calculation.

55424 (ANL—79-41, pp 313-315) **Combining beams in transverse space in a linear system.** Foss, M. (Argonne National Lab., IL). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The brightness factor resulting when several ion beams are combined is presented. The resulting brightness is greater than 3/4 of the original brightness for the cases when 1, 2, 3, 4, and 15 beams are combined. A way of increasing the current from one linac by a factor of 16 is shown.

55425 (ANL—79-41, pp 317-320) **High current transport of non K-V distributions.** Haber, I. (Naval Research Lab., Washington, DC). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Numerical calculations are presented which compare the emittance of beams with Kapchinskii-Vladimirskii (K-V) distributions and with non K-V, high current distributions, in alternate gradient transport systems.

55426 (ANL—79-41, pp 321-324) **Comparison of instability theory with simulation results.** Laslett, L.J. (Lawrence Berkeley Lab., CA); Smith, L.; Haber, I. 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The results of a quantitative comparison between linear instability theory and simulation results for a third order charge fluctuation mode in a quadrupole - focused beam are summarized. The theory is found to provide a good account of the initial instability exhibited by the simulation computations.

55427 (ANL—79-41, pp 333-343) **Geometric aberrations in final focussing for heavy ion fusion.** Neuffer, D. (Lawrence Berkeley Lab., CA). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

A general formulation is developed to estimate third-order distortions of ion beams without detailed calculations. Several candidate heavy ion fusion (HIF) beams are discussed in detail as examples. Some general ideas on constraints which third-order aberrations place on HIF parameters are developed.

55428 (ANL—79-41, pp 345-354) **Quadrupole systems for focussing ion beams with large momentum spread.** Steinhoff, J. 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

A series of computer optimization studies were made for systems with 6, 28, and 64 quadrupole magnets, focussing beams with different momentum spreads. Ideal magnets were assumed and only chromatic abberations were considered. Also, space charge was neglected. Since $\Delta p/p$ was allowed to be large enough to substantially change the trajectories, the equations of motion were not expanded in $\Delta p/p$. Instead, the spot size at the target was computed and minimized over an interval of p. We also considered the possibility of simultaneously focussing, with the same quadrupole system, two beams, each with moderate $\Delta p/p$ (+-1/4%) but differing by 10 to 40% in charge/momentum (Q/p). Such a system would allow two pulses, each in the same charge state but with different velocities to propagate separately through the system and telescope into each other at the end. In this way, space charge effects could be reduced.

55429 (ANL—79-41, pp 355-364) **Octupole correction of third order aberration.** Fenster, S. (Argonne National Lab., IL). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The strength of an octupole system required to correct a typical final focussing third order aberration in an ion beam fusion system is computed. An example of a 20 GeV Xe^{+3} system is considered.

55430 (ANL—79-41, pp 365-378) **Correction of chromatic and geometric aberrations using sextupoles and octupoles.** Colton, E. (Argonne National Lab., IL). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The procedure for applying some chromatic corrections to a final transport line, neglecting space charge, utilizing the method suggested by Brown is described. The possibility of including octupoles into a point-to-point triplet system, as outlined by Fenster is studied. Positive results were obtained in both cases: (i) using 2 + I correcting sections with two pairs of non-interlaced sextupoles increased the fraction of beam with $\Delta P/P = 1\%$ onto a 0.1 cm radius target by more than a factor of 1.75; (ii) six octupoles placed into a point-to-point triplet system increased the fraction of a full emittance $\Delta P/P = 0\%$ beam striking a 0.1 cm radius target by a factor of 2.5.

55431 (ANL—79-41, pp 387-392) **Disruption of geometric focus by self-magnetic fields.** Mosher, D. (Naval Research Lab., Washington, DC); Goldstein, S.A. 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The perturbation of ballistic ion orbits due to the azimuthal magnetic field associated with incomplete current neutralization is investigated. It is shown that 1% current non-neutralization is sufficient to disrupt the millimeter-radius focus desired for present reactor scenarios. Implications of these results and directions for future research are discussed.

55432 (BNL—26585) **Ion production and trapping in electron rings.** Gluckstern, R.C.; Ruggiero, A.G. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 18p. Dep. NTIS, PC A02/MF A01.

The electron beam in the VUV and X-ray rings of NSLS will ionize residual gas by collisions. Positive ions will be produced with low velocity, and will be attracted by the electron beam to the beam axis. If they are trapped in stable (transverse) orbits, they may accumulate, thereby increasing the ν/sub x,z/ of the individual electrons. Since the accumulated ions are unlikely to be of uniform density, a spread in ν/sub x,z/ will also occur. Should these effects be serious, it may be necessary to introduce clearing electrodes, although this may increase Z/n in the rings, thereby adding to longitudinal instability problems. The seriousness of the above effect for the VUV and X-ray rings is estimated.

55433 (IFVE-M—24(Pt.2), pp 374-379) **Precision energy measurement technique.** Farkas, Z.D.; Martin, H.L.; Miller, R.H. (Stanford Univ., CA (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

In order to measure any correlation between the energy and polarization of the electron beam with a precision in $\Delta E/E$ of 0.001%, a time-of-flight energy measurement experiment is carried out at SLAC. The phase difference between two 2856 MHz signals induced in microwave cavities located before and after the bending magnets was measured using a precision energy measurement system. The pulse-to-pulse energy change histogram is plotted. The distribution had standard deviation (sigma=2.3) channels; i.e. sigma=0.010%. It is concluded that the pulse-to-pulse energy jitter of the beam is $\Delta E/E <= +-0.1\%$, and that the pulse-to-pulse energy resolution of the time-of-flight energy measurement system is $<=0.01\%$.

55434 (IFVE-M—24(Pt.2), pp 4-15) **Effects limiting accelerated beam intensity in the largest proton synchrotrons.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

Two major categories (single-particle dynamics and self-field effects) of beam-dynamical considerations in designing multi-TeV proton synchrotrons are discussed. The procedure for calculating the effect of errors in a superconducting magnet ring is presented. The magnitude of the emittance growth effect is given. Mathematical formulation and the method of solution for dynamic self-field phenomena are presented. It is shown that an initial nonstationary and unstable distribution grows in a manner similar to a stationary and unstable one. All coherent instabilities can be damped by the use of a feedback system.

55435 **Resolving beam transport problems in electrostatic accelerators.** Larson, J.D. (Oak Ridge National Lab., TN (USA)). *Rev. Phys. Appl.;* **12**: No. 10, 1551-1561(Oct 1977).

This paper reviews problem areas in beam transmission which are frequently encountered during the design, operation and upgrading of electrostatic accelerators. Examples are provided of analytic procedures that clarify accelerator ion optics and lead to more effective beam transport. Suggestions are made for evaluating accelerator design with the goal of improved performance.

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 55848

55436 (LA-UR—79-2419) **LAMPF first-fault identifier for fast transient faults.** Swanson, A.R.; Hill, R.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790927—1). Dep. NTIS, PC A02/MF A01.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The LAMPF accelerator is presently producing 800-MeV proton beams at 0.5 mA average current. Machine protection for such a high-intensity accelerator requires a fast shutdown mechanism, which can turn off the beam within a few microseconds of the occurrence of a machine fault. The resulting beam unloading transients cause the rf systems to exceed control loop tolerances and consequently generate multiple fault indications for identification by the control computer. The problem is to isolate the primary fault or cause of beam shutdown while disregarding as many as 50 secondary fault indications that occur as a result of beam shutdown. The LAMPF First-Fault Identifier (FFI) for fast transient faults is operational and has proven capable of first-fault identification. The FFI design utilized features of the Fast Protection System that were previously implemented for beam chopping and rf power conservation. No software changes were required.

ION SOURCES

REFER ALSO TO CITATION(S) 55423

55437 (IFVE-M—24(Pt.2), pp 148-156) **Calculation of positron source yields.** James, M.B.; Miller, R.H.; Woo, B.M. (Stanford Univ., CA (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

An investigation on some design changes of the SLAC positron source coil to make the coil more conservative was carried out. The goals for the new design were to eliminate the internal brazed joints in the conductor, to improve the iron configuration in order to achieve equal or higher field with reduced current density and to reduce the power consumption of the coil. Two alternates of the new design of the 4-coil assembly and 6-coil assembly have been considered. The positron distributions for 7-GeV electrons incident on 5 cm thick target of copper and 1.9 cm thick target of tungsten were calculated. The obtained calculation results showed that the new coil with 4 pancakes, which uses 24% less power, gives 26% larger yield than the present coil.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 55419, 55456, 55714, 55760, 55768

55438 (BNL—50847, pp 149-168) **UNISOR project: techniques and results.** Spejewski, E.H. (Oak Ridge Associated Universities, TN). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The history and facilities at UNISOR (Universities Isotope Separator at Oak Ridge) are described in detail. Special attention is given to the ion source, beam and source handling, and data acquisition. Some results on even-mass Hg isotopes and odd-mass Au isotopes and their significance are discussed. 9 figures. (RWR)

55439 (BNL—50847, pp 237-245) **Thermochromatographic separations on-line.** D'Auria, J.M. (Simon Fraser Univ., Burnaby, British Columbia). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The technique of on-line gas-phase thermochromatographic separation is described. A schematic diagram of the thermochromatographic apparatus for continuous separation of the fission product bromides with a gas jet as the transport method for the reaction products is shown. Advantages and drawbacks of this relatively new technique for performing fast chemical separations are pointed out. 2 figures. (RWR)

55440 (CONF-790610—4) **Characteristics and performance of a new magnet system for 180° electron scattering.** Peterson, G.A. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy). 1979. Contract EY-76-S-02-2853. 6p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

A four-magnet 180° scattering system for use with the energy-dispersed beam of the 400 MeV Bates Linear Accelerator at the University of Massachusetts is described. (GHT)

55441 (COO—3069-677, pp 269-296) **Experimental problems in nucleon knockout reactions: techniques for producing effective monochromatic photons using bremsstrahlung.** Matthews, J.L. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The well known methods of producing effective monochromatic photons using the bremsstrahlung spectrum are reviewed. Techniques most appropriate for particular experiments in the medium experiments in the medium energy range are indicated, and possible extensions of these techniques are suggested. 35 references. (JFP)

55442 (LA-UR—79-2137) **Report on the Los Alamos Kaon Factory seminar: physics.** Silbar, R.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-790847—5). Dep. NTIS, PC A02/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

The motivations, discussions, and preliminary conclusions of the LASL Kaon Factory Seminar, which met 15 times in the Spring of 1979, are reported. It is technically feasible, but expensive, to build a kaon factory using LAMPF as an injector. Taking advantage of the increased beam intensity, excellent secondary beam lines could be built. While we continue further study of the physics justification for a kaon factory, we also propose to gradually increase LASL participation in kaon and antiproton physics.

55443 **Quasi-static drift-tube accelerating structures for low-speed heavy ions.** Faltens, A.; Keefe, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Part. Accel.;* 8: No. 4, 245-253(Jun 1978).

A pulsed drift-tube accelerating structure for use in Heavy Ion Fusion applications is described. Possible arrangements of components in such a structure, the injector design needs, and the influence of the existing state of component technology on drift-tube structure design are considered. It is concluded that the major attractions of the pulsed drift tubes are that they are nonresonant structures and that they appear suitable for accelerating a very high current bunch at low energies. The mechanical tolerances of the nonresonant structure are very loose and the cost per meter should be low; the cost of the transport system is expected to be the major cost. The pulse-power modulators used to drive the drift tubes are inexpensive compared with rf sources of equivalent peak power. The longitudinal emittance of the beam emerging from the structure could be extremely low.

STORAGE RINGS

55444 (BNL—26567) **Magnet leads for the First-Cell.** Brown, D.P.; Schneider, W.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 14p. (CONF-790815—18). Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Portions of document are illegible.

The ISABELLE refrigeration system utilizes compressed liquid helium to supply refrigeration to nearly 1100 superconducting bending and focusing magnets. These magnets steer the proton orbits of the accelerator and are arranged into two interlocking rings. The magnet leads used to power, correct and trim these superconducting magnets make up a substantial portion (25%) of the total heat load that the refrigerator must be capable of supplying. These magnet leads have been designed to minimize the heat input into the refrigeration system. The design and preliminary test results of four different types of leads in use on the ISABELLE prototype, the First-Cell, are described.

55445 (BNL—26591) **Ultra high vacuum system for Isabelle full cell.** Skelton, R.; Briggs, J.; Chou, T.S.; Foerster, C.; Stattel, P. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 11p. (CONF-791013—3). Dep. NTIS, PC A02/MF A01.

From 26. national vacuum symposium; New York, NY, USA (2 Oct 1979).

A vacuum system consisting of a 40 m long 8.8 cm diameter stainless steel tube, pumped by 7 pumping stations, has been assembled using automatic welding methods. All components have been fired at 950°C in a vacuum furnace at a pressure $< 1 \times 10^{-4}$ Torr. Each pumping station contains a Ti-sublimator, a 30 liter/s ion pump and an UHV gauge. After assembly, the entire system was baked out at 250°C for 24 hours. A pressure $< 1 \times 10^{-11}$ Torr was reached after titanium flash. Surface treatment of stainless for 10^{-11} Torr operation, bake out and conditioning cycle to read 1×10^{-11} Torr, and leak checking at low pressures are discussed.

55446 (IFVE-M—24(Pt.2), pp 294-3O1) **Proton accumulator ring injection studies.** Cooper, R.K.; Neil, V.K. (Los Alamos Scientific Lab., NM (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

The purpose of the study was to investigate the evolution of the distribution of protons in longitudinal phase space during an injection process into a proton accumulator ring. The LAMPF 800 MeV linac was taken as the source of particles for the ring. $5x10^8$ particles are injected into each bucket each turn. Two calculations were performed. The purpose of the first calculation was to determine the rf voltage necessary to overcome the longitudinal self-forces. In the second calculation the rf was turned off. The distribution functions after 200 turns with 100 kV rf voltage, after 100 turns (no rf) and after 200 turns (no rf) were calculated. The bunches were well distributed in azimuth. No effects of the finite resistance were apparent.

55447 (IFVE-M—24(Pt.2), pp 192-201) **Superconducting magnetic program at Brookhaven National Laboratory.** Dahl, P.F. (Brookhaven National Lab., Upton, NY (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

The present state of the superconducting magnet research and development program for the Isabelle intersecting storage accelerator is outlined. Isabelle dipoles and quadrupoles will operate in series, and will be cooled by forced circulation of high pressure helium gas. The dipole design field is 4.0 T, operating current is 3.3 kA, weight of magnet is 5000 kg. Six full-size dipoles have been completed and tested. The results of quench performance are given. One full-scale quadrupole, has been constructed. The total weight of magnet is 1000 kg, the design gradient is 53 T/m. Isabelle half-cell, consisting of two dipoles and a quadrupole is going to complete. Four large-aperture dipole magnets of the design field of 4.0 T have operated without incident in the high energy unseparated beam line. Several one-meter long dipoles of 8 cm aperture using conductors braided from Nb_3Sn filamentary wire have been constructed and tested.

55448 (IFVE-M—24(Pt.2), pp 55-63) **Polarized particles in storage rings.** Derbenev, Ya.S.; Kondratenko, A.M.; Serednyakov, S.I.; Skrinskii, A.N.; Tumaikin, G.M.; Shatunov, Yu.M. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1977. (In Russian).

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

Experiments with polarized beams on the VEPP-2M and SPEAR storage rings are described. Possible methodss of producing polarized particle beams in storage rings as well as method of polarization monitoring are recounted. The processes of radiation polarization of electrons and positrons are considered. It is shown that to preserve radiation polarization the introduction of regions with a strong sign-variable magnetic field is recommended. Methods of polarization measurement are recounted. It is suggested for high energies to use dependence of synchrotron radiation power on transverse polarization of electrons and positrons. Examples of using polarizability of colliding beams in storage rings are presented.

55449 (IFVE-M—24(Pt.2), pp 185-190) **Fast pulse beam generation systems for electron accelerators.** Koontz, R.F. (Stanford Univ., CA (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

The fast pulse beam generation system to supply the SLAC storage ring, SPEAR, with two one nanosecond bunch electron beam pulses is described. Generation of these pulses is accomplished with a combination of a fast pulsed gridded gun and a synchronized transverse beam chopper. The fast gun based on spherical cathode-grid assembly has output current up to 2As. The fast pulse amplifier system can handle trains of short pulses with repetition rates up to 40 MHz during the 1.6 μs normal accelerating time. The chopping deflector system consists of a resonant coaxial line with deflecting plates. The resonator frequency is 39.667 MHz. A schematic diagram of the resonant system is shown. The fast beam pickup system has a one hundred picosecond rise time overall. Fast beam generation and chopper systems permit one to generate almost any short or single bunch beam profile needed for experiments.

55450 (IFVE-M—24(Pt.2), pp 260-265) **Computer simulation of bunch lengthening and widening in proton storage rings.** Ruggiero, A.G. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

In order to study bunch lengthening, computer simulations of the motion of proton bunches in a machine like the Fermilab main ring or energy doubler were performed. An assumption was that around the ring there is an impedance, frequency independent and real, that excited by the bunch current creates a longitudinal force capable of distorting the bunch shape and size. A formula which gives the bunch growth as a function of machine and beam parameters is derived.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 54834, 55612

55451 (LA—7779-M) **High-level neutron coincidence counter (HLNCC): users' manual.** Krick, M.S.; Menlove, H.O. (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 109p. Dep. NTIS, PC A06/MF A01.

This manual describes the portable High-Level Neutron Coincidence Counter (HLNCC) developed at the Los Alamos Scientific Laboratory (LASL) for the assay of plutonium, particularly by inspectors of the International Atomic Energy Agency (IAEA). The counter is designed for the measurement of the effective ^{240}Pu mass in plutonium samples which may have a high plutonium content. The following topics are discussed: principle of operation, description of the system, operating procedures, and applications.

55452 (SAND—79-1339C) **Energy deposition measurements in fast reactor safety experiments with fission thermocouple detectors.** Wright, S.A.; Scott, H.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-791103—11). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The investigation of phenomena occurring in in-pile fast reactor safety experiments requires an accurate measurement of the time dependent energy depositions within the fissile material. At Sandia Laboratories thin-film fission thermocouples are being developed for this purpose. These detectors have high temperature capabilities (400 to 500°C), are sodium compatible, and have milli-second time response. A significant advantage of these detectors for use as energy deposition monitors is that they produce an output voltage which is directly dependent on the temperature of a small chip of fissile material within the detectors. However, heat losses within the detector make it necessary to correct the response of the detector to determine the energy deposition. A method of correcting the detector response which uses an inverse convolution procedure has been developed and successfully tested with experimental data obtained in the Sandia Pulse Reactor (SPR-II) and in the Annular Core Research Reactor (ACRR).

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 55687, 55692

55453 (BNL—25540) **New instruments and techniques in neutron capture studies.** Kane, W.R. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 18p. (CONF-780926—25). Dep. NTIS, PC A02/MF A01.

From 3. symposium on neutron capture of gamma-ray spectroscopy; Upton, NY, USA (18 Sep 1978).

Three general topics are addressed. The first deals with crystal diffraction gamma-ray spectrometers, in particular, with the highly productive GAMS spectrometers at the ILL reactor in Grenoble. They are described in detail because of their great potential for producing capture gamma-ray data of the highest quality. Future possibilities for other developments in the area of crystal diffraction spectroscopy of capture gamma rays are also mentioned. Improved neutron beam facilities for capture gamma-ray experiments are discussed within the general framework of the subject of the production of high-quality thermal neutron beams under a variety of conditions. Finally, a magnetic spectrometer for studies of internal conversion electrons emitted after thermal neutron capture, now nearing completion at the BNL High Flux Research Reactor, is described in some detail. Its characteristics are compared with those of the high-performance (n,e) spectrometer BILL at the ILL research reactor in Grenoble. 2 figures. (RWR)

55454 (IS-T—859) **Versatile pulse programmer for pulsed nuclear magnetic resonance spectroscopy.** Adduci, D.J. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 89p. Dep. NTIS, PC A05/MF A01.

Thesis.

A description of the sequence of events and the decisions leading to the design of a versatile pulse programmer for pulsed NMR are presented. Background and application information is discussed in order that the reader might better understand the role of the pulse programmer in a NMR spectrometer. Various other design approaches are presented as a basis for comparison. Specifications for this design are proposed, the hardware implementation of the specifications is discussed, and the software operating system is presented.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

55455 (SAND—79-1273C) **Radiation-hardened bulk Si-gate CMOS microprocessor family.** Stricker, R.E.; Dingwall, A.G.F.; Cohen, S.; Adams, J.R.; Slemmer, W.C. (RCA Solid State Technology Center, Somerville, NJ (USA); Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790706—6). Dep. NTIS, PC A02/MF A01.

From 1979 IEEE Annual conference on nuclear and space radiation effects; Santa Cruz, CA, USA (17 Jul 1979).

RCA and Sandia Laboratories jointly developed a radiation-hardened bulk Si-gate CMOS technology which is used to fabricate the CDP-1800 series microprocessor family. Total dose hardness of 1 x 10^6 rads (Si) and transient upset hardness of 5 x 10^8 rads (Si)/sec with no latch up at any transient level was achieved. Radiation-hardened parts manufactured to date include the CDP-1802 microprocessor, the CDP-1834 ROM, the CDP-1852 8-bit I/O port, the CDP-1856 N-bit 1 of 8 decoder, and the TCC-244 256 x 4 Static RAM. The paper is divided into three parts. In the first section, the basic fundamentals of the non-hardened C^2L technology used for the CDP-1800 series microprocessor parts is discussed along with the primary reasons for hardening this technology. The second section discusses the major changes in the fabrication sequence that are required to produce radiation-hardened devices. The final section details the electrical performance characteristics of the hardened devices as well as the effects of radiation on device performance. Also included in this section is a discussion of the TCC-244 256 x 4 Static RAM designed jointly by RCA and Sandia Laboratories for this application.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 54114, 54739, 54933, 55191

55456 (BNL—26586) **Design optimization of straight groove toroidal grating monochromators for synchrotron radiation.** McKinney, W.R.; Howells, M.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 29p. (CONF-790651—6). Dep. NTIS, PC A03/MF A01.

From National conference on synchrotron radiation instrumentation; Gaithersburg, MD, USA (4 Jun 1979).

The availability of storage rings giving intense broadband radiation in the spectral range 10-500A has prompted renewed interest in the improvement of grazing incidence monochromators. Of particular importance is the moderate resolution case designed for highest throughput. This report outlines the reasons behind the various choices leading to a toroidal grating monochromator design, and indicates a method for finding optimum values for some of the parameters in the straight grooved case. This case is chosen because, at present, all aberration corrected gratings contain photoresist on their surfaces, and are therefore unsuited for use with high intensity synchrotron radiation. Fixed entrance and exit slit to grating distances and wavelength scanning by simple rotation of the grating about its pole are assumed.

55457 (IS-T—864) **Design of a low temperature translation balance for the measurement of paramagnetic and diamagnetic susceptibilities.** Mowry, G.S. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 54p. Dep. NTIS, PC A04/MF A01.

Thesis.

A modified Foex and Forrer Translation Balance has been designed for measuring the paramagnetic and diamagnetic properties of materials over the temperature range 77-300°K. The systems' temperature range can eventually be extended to 4.2°K. The apparatus incorporates a vertical Dewar of Standard variety in addition to a horizontal Dewar for cooling the sample holder and adjacent horizontal supports. The design also allows for the placement of a thermocouple junction in direct contact with a sample. The balance sensitivity, defined as the change in displacement per unit applied force, is 0.0044 cm/dyne. The precision of the balance is +- .5% with an accuracy of 1.5%.

55458 (SAND—79-8250) **W82 structural telemetry system.** Peila, W.C. (Sandia Labs., Livermore, CA (USA)). Sep 1979. Contract EY-76-C-04-0789. 47p. Dep. NTIS, PC A03/MF A01.

The W82 structural telemetry system was designed to monitor structural responses and define in-barrel environments during 155 mm gun tests of the W82 artillery fired projectile. Electronically, the TLM is of the FM/FM type providing 13 continuous data channels, primarily strain and acceleration, with frequency responses from 1 kHz to 8 kHz. With the exception of the battery and transmitter, the system is reusable with a modular design permitting relatively simple replacement of channels. At the time of writing, the system had been used on more than 30 W82 tests, surviving, operating, and monitoring axial accelerations exceeding 18,000 g's, radial accelerations to 20,000 g's and torsional impulses (tangential) to 3000 g's.

55459 (UCID—17995) **Processing of poly-Si electrodes for charge-coupled devices.** Sherohman, J.W.; Cook, F.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Dec 1978. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

A technique has been developed to fabricate poly-Si electrodes for charge-coupled devices. By controlling the microstructure of a poly-Si film, an anisotropic etchant was selected to provide essentially uniform electrode width dimensions. The electrode widths have only a 6% variation for the majority of the devices over the area of a 2 inch silicon wafer.

55460 (UCRL—81871) **Atomic absorption spectrometer readout and data reduction using the LSI-11 microcomputer.** Allen, M.J.; Wikkerink, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Nov 1978. Contract W-7405-ENG-26. 9p. (CONF-781159—8). Dep. NTIS, PC A02/MF A01.

From Fall DECUS U.S. symposium; San Francisco, CA, USA (27 Nov 1978).

Some common instruments found in the chemistry laboratory have analog chart recorder output as their primary data readout media. Data reduction from this medium is slow and relatively inaccurate. This paper describes how to interface a single LSI-11 microcomputer to PERKIN-ELMER models 603 and 303 Atomic Absorption Spectrophotometers.

WELL LOGGING INSTRUMENTATION

55461 **Measurement of rock density and prospecting for heavy metallic ore deposits by using γ-γ logging.** Nakai, J. *Chishitsu Chosasho Geppo;* **29**: No. 1, 1-59(Jan 1978). (In Japanese).

The consideration on two forms of gamma-gamma logging is presented in this paper. One is a density logging of rocks, which is based on Compton scattering of gamma rays by rock electrons, and the other is one type of so-called selective gamma-gamma logging, which is on the basis of photoelectric absorption of gamma rays by heavy elements in the rocks or ores.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 55467

55462 (LA—7760-MS) **Estimation of the density of organic explosives from their structural formulas.** Cady, H.H. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 24p. Dep. NTIS, PC A02/MF A01.

The explosives community spends considerable time, effort, and money in synthesizing and determining physical properties of compounds to find better explosives. When better means more powerful, density is the most important property to be determined. A technique for predicting the density of an organic (C-H-N-O-Cl-F) compound given its proposed structural formula is presented.

55463 (SAN—0115/117) **Mechanisms of nitramine decomposition: very low-pressure pyrolysis of HMX and dimethylnitramine. Final report.** McMillen, D.F.; Barker, J.R.; Lewis, K.E.; Trevor, P.L.; Golden, D.M. (SRI International, Menlo Park, CA (USA)). 18 Jun 1979. Contract EY-76-C-03-0115-117. 36p. Dep. NTIS, PC A03/MF A01.

The very low-pressure pyrolysis (VLPP) of cyclotetramethylenetetranitramine (HMX) and dimethylnitramine have been studied over the temperature ranges 530 to 645°K and 550 to 840°K, respectively. High pressure limit Arrhenius parameters for HONO elimination and $N\text{-}NO_2$ bond scission in dimethylnitramine have been determined to be log $k(sec^{-1})$ = 12.4 +- 0.8 - (37 +- 1.8)/2.3 RT and log $k(sec^{-1})$ = 16.5 +- 0.8 - (48.5 +- 1.8)/2.3 RT, respectively. Use of the dimethylnitramine decomposition parameters as models for HMX decomposition suggests that HONO elimination and $N\text{-}NO_2$ bond scission should have equal rates at about 600°K. Above this temperature, $N\text{-}NO_2$ bond scission will become increasingly predominant. The observed temperature dependence of HMX decomposition is consistent with an activation energy $\leq$ 40 kcal/mole, but the data are too scattered to completely rule out the 45.50 kcal/mole which would signify initial $N\text{-}NO_2$ bond scission. The decomposition of HMX yields m/e 46 as a major initial product mass, consistent with either pathway, but not consistent with either concerted or stepwise depolymerization as the probable initial step(s) in HMX decomposition.

55464 (UCID—18265) **Detonation physics program.** Erickson, L.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1979. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

The Detonation Physics Program is aimed at furthering an understanding of the intiation and detonation process in chemical high explosives (HE's). To this end, a 101 mm light gas gun is used as a tool to produce a plane wave shock in various configurations of explosives. Specially developed gauges are used to measure pressure and particle velocity as a function of time at various points in the reactuive flow (in both the initiation and detonation regimes). Impact flatness is a critical factor in the analysis of the experimental results.

NUCLEAR

55465 (UCID—18250) **Finite element analysis of stemming loads on pipes.** Maiden, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 39p. Dep. NTIS, PC A03/MF A01.

A computational model has been developed for calculating the loads and displacements on a pipe placed in a hole which is subsequently filled with soil. A composite soil-pipe finite element model which employs fundamental material constants in its formalism is derived. The shear modulus of the soil, and the coefficient of friction at the pipe are the important constants to be specified. The calculated loads on the pipe are in agreement with experimental data for layered and unlayered stemming designs. As a result more economical designs of the pipe string can be realized.

CIVIL USES

REFER ALSO TO CITATION(S) 54239

55466 (NVO—202(Add.B)) **Project Gnome Decontamination and Decommissioning Plan.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). 1979. 4p. Dep. NTIS, PC A02/MF A01.

The purpose of Addendum B is to identify required changes from the Project Gnome Decontamination and Decommissioning Plan (NV-202). The changes are necessitated as a result of the near cavity fill-up of the contaminated salt and soil prior to the downhole disposition of the total volume of uncontaminated salt. An alternative disposition plan for salt burial, as noted in Addendum A, is therefore necessary. Additional long term monitoring objectives are also addressed. (TFD)

WEAPONRY

55467 (MHSMP—79-33) **Lot qualification procedure for HNS-II ALSC.** Campos, C.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jul 1979. Contract EY-76-C-04-0487. 8p. Dep. NTIS, PC A02/MF A01.

The development status of a lot qualification procedure for HNS-II aluminum-linear-shaped-charge (ALSC) for the B77 MC 3125 component prior to the cancellation of the program is described. At the time of cancellation the first operational model of a test fire fixture to qualify the HNS-II ALSC as received from the vendor had been completed.

55468 (SAND—79-8253) **Load-deflection test of candidate B83 mitigator materials. Test Report No. 2304.** Guntrum, W.R.; Snyder, M.F. (Sandia Labs., Livermore, CA (USA)). Aug 1979. Contract EY-76-C-04-0789. 53p. Dep. NTIS, PC A04/MF A01.

Load-deflection tests were made on candidate B83 mitigator materials including glass reinforced phenolic honeycomb, Kerimid foam, and polyurethane foam. The tests were conducted at temperatures of -60°F, 70°F, and 160°F and at several different strain rates. These tests were conducted during April and May 1979.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

55469 (BNL—50993) **Abstracts of reports published in the environmental programs of the Department of Energy and Environment, January-December 1978.** (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 105p. Dep. NTIS, PC A06/MF A01.

This 1978 Annual Abstracts represents the publishing experience over the past year of the three divisions and one group that make up the Environmental Sciences area of the Department of Energy and Environment. The abstracts are grouped according to the organization of the authors under the Atmospheric Sciences, Environmental Chemistry, and Oceanographic Sciences Division and the Land and Fresh Water Environmental Sciences Group. The range of interests and the interdisciplinary nature of the activities within Environmental Programs are demonstrated by these abstracts. Most of these activities relate in some way to the environmental effects or potential effects of energy generation. The major areas involved include: coastal meteorology; physical, biological, and chemical oceanography of the coastal shelf; analysis of marine, fresh water, and terrestrial ecosystems; effects of acid rain and other pollutants on aquatic and terrestrial systems; Multistate Power Production Pollution Study (MAP3S), including transport and transformation experiments, data management, and modeling and analysis; atmospheric diagnostics including the study of the chemistry of pollutants in plumes and ambient atmosphere; basic and applied studies of atmospheric aerosol generation, composition, and behavior; and development of atmospheric tracer systems and real-time instrumentation.

BASIC STUDIES

REFER ALSO TO CITATION(S) 55502, 55536, 55622

55470 (ATDL—78/19, pp 19-31) **Atmospheric Turbulence and Diffusion Laboratory. Deciduous Forest Meteorology Research Program: an overview.** Hutchison, B.A. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

The research aims and philosophy of the deciduous forest meteorology program are reviewed. The objectives of the research program include but are not necessarily limited to: determination of the space and time distribution of microclimatic variables of importance to the functioning of the ecosystem; determination of the effects of soil moisture conditions upon forest microclimate through physical and physiological mechanisms; quantification of the effects of changing seasons and phenological changes in forest structure upon forest microclimate; quantification of the space and time distribution of stomatal resistances and the relationship of these resistances to forest physiology and microclimate; relating the space and time distributions of radiative energy fluxes to forest structure, phenology, and primary productivity; measurement of the vertical turbulent fluxes of mass, sensible heat, and momentum through the forest volume; and, determination and quantification of the structural characteristics of the forest governing these turbulent fluxes. To realize these objectives, a ridge-top site in an oak-hickory forest has been selected near the Walker Branch Watershed research facility on the US Department of Energy (USDOE) Reservation near Oak Ridge, Tennessee. This site is being instrumented with a network of sensors of two main types. One set consists of relatively slow response sensors mounted on moving carriages and replicated in vertical space. These will yield measures of the space and time distributions and mean values of slowly changing microclimatic variables. The second set of sensors are fast response instruments used to measure the turbulent fluctuations in wind, temperature, and humidity as required for eddy correlation calculations of turbulent fluxes.

55471 (ATDL—78/19, pp 63-66) **Characterization of deciduous forest radiation regimes.** Hutchison, B.A.; Matt, D.R.; McMillen, R.T. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

CO_2 fixation amounts at various levels in a tulip poplar canopy were calculated from observed daily radiant flux density frequency distributions and compared to those calculated from daily mean values as well as from the Gaussian and gamma distributions derived from the observed data. Photosynthesis calculated using the gamma distribution more closely approximate those calculated from the observed distributions than any of the other estimates.

55472 (ATDL—78/19, pp 67-68) **Analytical representation of solar radiation flux density distribution in a deciduous forest.** Matt, D.R.; Hutchison, B.A.; McMillen, R.T. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

Skewness and kurtosis of solar radiation data collected in a deciduous forest indicate that radiant flux density frequency distributions can be represented by a family of gamma distribution functions. Kolmogorov-Smirnov goodness of fit comparisons with normal and lognormal distributions confirm the gamma distribution.

55473 (ATDL—78/19, pp 235-245) **Mesoscale flow over complex terrain during the Eastern Tennessee Trajectory Experiment (ETTEX).** Nappo, C.J. Jr. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

Time-averaged, mesoscale flow fields over complex terrain measured during the Eastern Tennessee Trajectory Experiment (ETTEX) are analyzed in terms of the horizontal means, standard deviations from the horizontal means, and the kinetic energies of the uniform and nonuniform flow components. The vertical profiles of

horizontally averaged wind speed and direction shear over flat and complex terrain during different stability conditions are compared. It is shown that the horizontally averaged flow over the ETTEX region was similar to that over a rough but otherwise flat urban area, and that surface layer of a few hundred meters thickness existed in which the influence of the large-scale topographic features was not felt. Horizontal variability of the wind field is measured by forming the standard deviations of the wind speed σ/sub s/ and direction $\sigma\theta$, and the ratios of horizontal eddy to mean kinetic energy, EKE/MKE. It is shown that while both methods represent the variability well, the analysis using kinetic energies offers the most quantitative information. During unstable conditions, horizontal variability was low and constant with height and tended to be independent of terrain, while during stable conditions the variability was high and nonuniform with height and was strongly dependent on terrain. It is hypothesized that during unstable conditions, horizontal uniformity of the wind resulted from the homogeneous action of the time-averaged, convective overturning, while during stable conditions, horizontal variability resulted from flow channeling and drainage. Further, above a surface layer of a few hundred meters, EKE/MKE tended to be constant for all stability classes.

55474 (ATDL—78/19, pp 253-262) **Numerical study of warm-air advection fog.** Rao, K.S.; Wyngaard, J.C.; Cote, O.R. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

The formation and dissipation of warm-air advection fogs due to variations in surface temperature are investigated by a higher-order turbulence closure theory. The steady-state two-dimensional model includes predictive equations for the mean quantities and turbulent fluxes. Using a simple radiation scheme, the model predicts the evolution of the mean wind, potential temperature, humidity, and liquid water profiles in the fog, as well as the trubulent flux distributions. The relative importance of advection, radiation, and turbulent transfer mechanisms in the energy and moisture budgets in the fog are discussed.

55475 (COO—2195-32) **Global transport processes and interactions with trace constituents. Annual progress report, 1 October 1978-30 September 1979.** Newell, R.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology). 18 Jun 1979. Contract EY-76-S-02-2195. 20p. Dep. NTIS, PC A02/MF A01.

Technical progress made in the period 1 October 1976 to 15 June 1978 is summarized. It was found that tropical Pacific sea temperature can be used to predict tropical air temperature several months ahead. Either Indian Ocean sea temperatures or volcanic aerosol may be used as a second predictor. Atmospheric CO_2 concentration also depends on tropical Pacific sea temperature, although whether the relationship occurs through the solubility effect or through the influence of the oceanic biosphere is not shown. A simple model for the temperature change accompanying a CO_2 doubling yields a temperature rise of less than 0.25°C, which is not in accord with other models.

55476 (UCRL—82548) **Prospects for monthly forecasts with 3-D global weather models.** Quirk, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jun 1979. Contract W-7405-ENG-48. 9p. (CONF-791038—1). Dep. NTIS, PC A02/MF A01.

From 4. conference on numerical weather prediction; Silver Spring, MD, USA (29 Oct 1979).

As domestic sources of fossil fuels have become less and less adequate, the need for improved methods of forecasting climate variations has grown. For example, some of the economic disruptions of the cold winter of 1976 to 1977 could have been avoided had more reliable forecasts been available. The stochastic dynamic forecast method proposed by Epstein (1969) is one way of improving forecast skill, but up until now it has not been possible to use it for two reasons: (1) stochastic forecasts would take a tremendous amount of computer time; and (2) present day models have such large errors in making forecasts for a particular place and time that the correction expected from using stochastic methods is much less than the actual errors. The purpose of this paper is to point out that model forecasts of space-time averaged quantities have much smaller errors than forecasts of quantities at a particular time and place. These errors are small enough that use of stochastic techniques can reduce forecast errors still further. The declining costs of computing and the greater need for forecast skill make stochastic methods look promising.

55477 **Spatial correlations of monthly rainfall: applications in climatology and weather modification experiments.** Patrinos, A.A.N.; Chen, N.C.J.; Miller, R.L. (Oak Ridge National Lab., TN). *J. Appl. Meteorol.;* **18**: No. 6, 719-732(Jun 1979).

Spatial correlations based on monthly rainfall totals from northwest Georgia for the period 1949 to 1977 are studied. This work, a part of the Meteorolgical Effects of Thermal Energy Releases (METER) Program, determines natural variability rainfall trends and assists the field studies of potential precipitation effects of the Bowen Electric Generating Plant near Cartersville, Georgia. The spatial correlations, based on the overall record as well as the stratified data in terms of wet and dry seasons, are investigated with regard to distance between stations, wind direction, and topography. The results indicate a strong dependence of the spatial correlation patterns on the prevailing storm tracks in the area. A method is developed using the spatial correlation as an indicator of effects in weather modification experiments. This method is based on the generation of empirical distribution functions by randomization for various sample sizes. The application of this technique to the Plant Bowen study in a control-target statistical design reveals preliminary positive evidence of rainfall modification in the target area.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54025, 54073, 54096, 54102, 54103, 54104, 55053, 55415, 55475, 55540, 55620, 55630

55478 (ATDL—78/19, pp 263-275) **Stability correction term for a simple urban dispersion model.** Hanna, S.R. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

The simple ATDL urban dispersion model is given by the equation $X_0 = CQ/U$, where X_0 is pollutant concentration measured at ground level, in amount per unit volume, Q is area source strength in amount per unit area per unit time, and U is wind speed (Hanna, 1971). Best results are obtained when area source strength Q is averaged over an area of about 10 square kilometers surrounding the receptor. The factor C in equation is a dimensionless parameter which is a function of stability and city size. In this report C is first derived theoretically and then estimated empirically using CO observations. The derived diurnal variability of C is used to estimate CO concentrations in Los Angeles, an independent data sample. The diurnal variation of the parameter $C = XU/Q$ was derived using CO emissions, CO concentrations, and wind speeds from many states. Except for the period 5 a.m. to 7 a.m., the hourly values of the empirically-derived C reflect changes in stability. During the period 5 a.m. to 7 a.m., advection also contributes to the measured variation in C, due to the rapid variation in emissions. The diurnal range of C corresponds roughly with theoretical estimates. It is expected that the values of C derived from CO measurements would apply equally well to area-source diffusion of other inert substances. The newly-derived diurnal C-curve was tested using an independent data set from Los Angeles. Agreement was good between observed and predicted hourly average CO concentrations for all times of the day except the evenings. It is suspected that diurnal stability patterns in Los Angeles during the evenings may be different from those in the eastern US, because of the unique topography of the Los Angeles basin.

55479 (ATDL—78/19, pp 329-332) **Observations of vortices in cooling tower plumes.** Hanna, S.R.; Pike, M.; Seitter, K. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

Time-lapse photography was used to estimate the speed of vortices in condensed plumes from a bank of mechanical draft cooling towers and a hyperbolic natural draft cooling tower. At a distance of about 30 m downwind from the towers, the median tangential velocity of the vortices at the edge of the plume is about 2 m s^{-1} in the downward direction, for ambient wind speeds of 7 to 13 m s^{-1}. The standard deviation of turbulent fluctuations of tangential speeds of the vortices is about 1.8 m s^{-1} for both types of towers.

55480 (ATDL—78/19, pp 107-130) **Urban modeling of inert substances.** Hanna, S.R. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

The physical assumptions in various models for the diffusion of inert substances in urban areas are critically reviewed. It is suggested that there is no significant difference among the predictions of the models, and that often simple integral models have more valid physical assumptions than complex computer models. Correlations between observed and predicted concentrations of CO, SO_2, and suspended particles are typically in the range 0.4 to 0.8. The magnitude of the prediction can be expected to be within a factor of two of the observation. Mixing depth and pollutant concentration are not well-correlated ($R \simeq -.2$) due to the fact that local pollutant plumes do not as a rule reach the capping inversion. Inverse wind speed and pollutant concentration are better correlated ($R \simeq .6$). A method for accounting for stability in the simple ATDL model is suggested, based on observations of CO emissions and concentrations and wind speeds at numerous stations.

55481 (CONF-790573—3) **Dry deposition of acid particles to natural surfaces.** Hicks, B.B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From 12. University of Rochester symposium on environmental toxicity: polluted rain; Rochester, NY, USA (21 May 1979).

Monitoring programs conducted over the northeastern continental USA during the past few years have indicated that sulfate particles present in air near the surface are often acidic. These

particles, which are typically small and hygroscopic, might be expected to attach themselves to foliage, thus imparting a strong but very localized dose of acid. At this time, the efficiency with which small particles attach themselves to leaf surfaces and the conditions under which they might be re-emitted by abrasion, for example, are largely unknown, and so a considerable uncertainty must be associated with any evaluation of the net effect. Application of deposition velocities in the range presently advocated for sulfate particles suggests acid fluxes by dry deposition that average about two orders of magnitude less than those probably resulting from rainfall. This should not be interpreted as an indication that dry deposition effects can be neglected, since it is clear that acid particles might reside on surfaces for considerable times, perhaps until washed off by rain or sufficiently diluted by dewfall.

55482 (CONF-7905108—1) **Role of tracer experiments in developing and testing pollutant dispersion models.** Yamada, T. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

From Atmospheric tracer workshop; Los Alamos, NM, USA (23 May 1979).

Many numerical models of pollutant dispersion have been developed, including several turbulence-closure models, but there are seldom enough data for proper model testing. Since the conservation equations involve many unknown variables, a large amount of data (which is used to replace some of the unknown variables) is needed for solving the model equations and testing the results. The amount of necessary data varies greatly from case to case. The unknown variables encountered in solving the model equations include meteorological variables, sources and sinks, initial and boundary conditions, and observations of pollutant concentration. Three model simulations, with surface topography varying from horizontal homogeneity to realistic heterogeneity, are selected here as examples. The results suggest a number of ways in which tracer experiments can aid in developing and testing pollutant dispersion models.

55483 (COO—1199-56) **Spatial variability of aerosol deposition in rain near St. Louis.** Gatz, D.F. (Illinois State Water Survey, Urbana (USA)). 1979. Contract EY-76-S-02-1199. 4p. (CONF-790415—40). Dep. NTIS, PC A02/MF A01.

From 177. national meeting of the American Chemical Society; Honolulu, HI, USA (1 Apr 1979).

Information on spatial variability of wet deposition available in the literature is reviewed. Data on variability measured in a St. Louis network of 80 open collectors, changed daily during summers from 1972 to 1975 are presented. Relative variability of deposition for elements having widespread sources at St. Louis (Li, Na, Mg, K, and Ca) exceeds values in the literature for similar network areas. However, this may result at least partially from the denser sampling network used at St. Louis, as seen in the proportionately greater variability of St. Louis rainfall. The variability of Zn deposition at St. Louis was considerably greater than that of rainfall and the elements with uniform source distributions, showing the effect of local sources on relative variability. (JGB)

55484 (EPA—600/9-77-044) **Research highlights, 1977.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Dec 1977. 62p. Environmental Protection Agency, Washington, DC.

This summary of research describes a cross-section of the work done in 1977 by the EPA Office of Research and Development. It is by no means a complete, in-depth report on all the activities of ORD, which sponsored more than 1,900 projects in 1977. What it does provide is a sampling of ORD projects, selected for review here because they represent breakthroughs in research, fill a practical technological void, are inherently interesting, or have implications for the future. Studies on cars, cancer, energy, water, pesticides, coke ovens, ozone, cheese, and waste are surveyed.

55485 (EPA—600/9-78-040) **Research highlights, 1978.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Dec 1978. 72p. GPO.

Some of the most interesting, fruitful, and far-reaching results of various research programs are reviewed. The topics covered include toxics, drinking water, ground water, measuring the minuscule, simulating the environment, municipal wastewater, rumble reader, assistance/emergencies, pollutant transport, nitrogen oxides, sulfur sludge, oil shale, diesels, monitoring air quality, air pollution index.

55486 (EPA—600/9-79-005) **Research Outlook 1979.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Feb 1979. 146p. GPO.

The research plan for 8 separate but interrelated EPA programs is described. Non-programmatic aspects of EPA research are also discussed. The intent of this document is to elucidate, in an informative and interesting manner, the goals, priorities, and expected results of key research programs. By focusing on the specifics of programs, this document is a continuation of the information contained in Research Outlook 1978. The environmental problems and associated research needs addressed by each progam are summarized then in some detail plans to fulfill those needs are discussed. Research milestones and expected dates of significant research results are tabulated in each program chapter. Chapter titles include: toxic substances, air pollution, industrial wastewater, watershed management, drinking water, energy and environment, solid waste, nonionizing radiation, global pollution, and anticipating environmental research needs. Five appendices and a bibliography are included. (JGB)

55487 (EPRI-EA—1066) **Implementation and coordination of the SUlfate Regional Experiment (SURE) and related research programs.** Mueller, P.K.; Hidy, G.M. (Environmental Research and Technology, Inc., Westlake Village, CA (USA). Western Technical Center). Jun 1979. 206p. Dep. NTIS, PC A10/MF A01.

The operating procedures for a comprehensive regional air quality program - the SURE program (SUlfate Regional Experiment) is described in detail. The coordination of SURE with other regional programs funded by the government or industry is also discussed. SURE is aimed at defining the relation between emitted primary pollutants (e.g., SO_2) and regional, ambient concentrations of secondary products (e.g., sulfates). Emphasis is on identifying the contribution of the electric power industry to ambient sulfate levels in the northeastern United States. This $6 million project began in early 1977 and will be completed in late 1979. SURE comprises four main elements: a ground monitoring network of 54 randomly distributed stations throughout northeastern United States; a program of measuring air quality from airplanes; a detailed emissions inventory; and a modeling program. The ground network was in operation for 15 months. Nine stations operated continuously; the remaining 45 gathered data continuously fr only one month out of each of the four seasons of the year. At all ground stations, a wide range of chemical and meteorological parameters was measured. Emphasis was on sulfur compounds; however, measurements also included nitrogen species, ozone, hydrocarbons, and some trace metals. The airborne work served as a limited supplement to the ground network in an attempt to add 3-dimensional character to the air quality measurements. The emissions inventory included SO/sub x/, NO/sub x/, suspended particles and hydrocarbons from power plants, other industry, homes, and surface transportation. Emissions are reported as daily averages for each season of the year. The modeling effort is aimed at developing a system which predicts regional concentrations of primary and secondary pollutants in terms of local emissions, taking into consideration other factors such as pollutant transport, chemical reaction, and meteorology.

55488 (EPRI-EA—1121) **Trace organic compounds in the New York City atmosphere. Part 1. Preliminary studies. Interim report.** Daisey, J.M. (ed.). (New York Univ., NY (USA). Inst. of Environmental Medicine). 1979. 104p. Dep. NTIS, PC A08/MF A01.

The principal objective of this preliminary investigation was to increase our knowledge of the kinds and concentrations of organic compounds present in New York City air, with particular emphasis on those classes which are biologically active (and which may pose a health hazard). The results indicate the presence of alkylating agents, N-nitrosamines and peroxides as well as polycyclic aromatic hydrocarbons. Direct-acting mutagens are also present in two polar and one non-polar organic fractions of particulate matter. Very little seasonal variation was observed in the mutagenic activity (per microgram) of the organic fractions. Airborne concentrations of extractable organic matter in total suspended particulate matter (TSP) do not appear to have changed significantly from the levels of 9 to 12 $\mu g/m^3$ in 1968 and 1969, although TSP has declined by more than 50%. Ambient levels of both non-polar and polar organics were found to be higher for the winter than the summer sampling period. This seasonal difference indicates that space heating is a significant source of some organic materials. The correlations found between three organic fractions of TSP and source tracers suggest that the polar oxidized hydrocarbons (acetone-extractables) are related directly to automobile emissions, while the moderately polar oxidized hydrocarbons (dichloromethane-extractables) appear to be related to photochemical reactions and automotive sources in summer and to heating sources in winter. It should be possible to develop correlation-regression methods for apportioning sources of organic aerosol matter based on the developments from a previous EPRI study. Such methods would be of value in comparing electric utility to other source contributions and in assessing the possible impact of changes in fuel use.

55489 (IVL-B—461) **Elevated ozone levels at the Swedish west coast and in southern Sweden (Skaane), using tobacco as an indicator plant.** Skaerby, L.; Grennfelt, P.; Lunneryd, S.G. (Swedish Water and Air Pollution Research Lab., Goeteborg). Apr 1979. 54p. Dep. NTIS (US Sales Only), PC A04/MF A01.

In the summer of 1977, an investigation was carried out to determine occurrence of ozone in southwestern Sweden, using tobacco plants as ozone-sensitive indicators. Through studying the frequency and intensity of injuries on tobacco at nine localities along

the west coast and three localities in the south, an idea was also obtained of potential injury of ozone on natural vegetation, agronomic crops, and forest trees. Three varieties of tobacco of different sensitivity were used, Bel W3, Bel C, and Bel B. Throughout the investigation period, continuous measurements of atmospheric ozone concentration were carried out at a background station on the west coast. Tobacco varieties Bel W3 and Bel C showed injury at all localities. The daily mean value of ozone ranged from 21 to 77 ppB and the maximum 1-hour mean value ranged from 34 to 102 ppB. No correlation between ozone concentration in the air and degree of injury on tobacco plants was found, but the cause of the injuries was definitely ozone. Some injury was observed on the oxone-tolerant variety Bel B. This may have been a synergistic effect of sulphur dioxide and ozone. Long-range transported pollutants probably caused the main part of the ozone injuries observed, but there are strong indications that some of them were caused by locally formed ozone. The intensity, frequency and distribution of injury on the tobacco plants indicate that ozone is likely to cause damage also to natural vegetation as well as agronomic crops and forest trees in Sweden.

55490 (LBL—9543) **Combustion sources of nitrogen compounds.** Brown, N.J.; Sawyer, R.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1977. Contract W-7405-ENG-48. 12p. (CONF-7703129—1). Dep. NTIS, PC A02/MF A01.

From Non-criteria nitrogenous air pollutants conference; Riverside, CA, USA (3 Mar 1977).

This communication describes some combustion sources of non-criteria nitrogeneous pollutants. Thermal and fuel-nitrogen production of NO are briefly described. The role of the automobile in the production of non-criteria nitrogen pollutants is summarized, and this is followed with a brief mention of non-criteria emissions from aircraft. The possible production of nitrogen compounds from the application of currently accepted abatement technology is discussed briefly.

55491 (ORAU/IEA—79-10(R)) **Carbon-13 from tree rings as a tracer in the carbon dioxide problem.** Bell, P.R. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Jun 1979. Contract EY-76-C-05-0033. 30p. Dep. NTIS, PC A03/MF A01.

This report is concerned with the current state of the analysis of the $^{13}C/^{12}C$ ratio in the wood of trees. The aim of such research is to provide an historical record of the $^{13}C/^{12}C$ ratio in the atmosphere. The $\delta^{13}C$ of the atmosphere is about -7 °/oo (departure of the $^{13}C/^{12}C$ ratio in parts per thousand from the PDB standard), while the $\delta^{13}C$ of coal and wood is about -25 °/oo, petroleum is about -28 °/oo, and natural gas is still more negative. The dilution of atmospheric CO_2 by CO_2 from these sources is expected to have already changed the atmospheric value by about 1 °/oo. It is hoped that the isotopic record in the trees will allow a better estimate of the effects of deforestation and industrial CO_2 input. There are many complicating effects in the tree isotopic record, and rather large differences are found between trees. If it is possible to obtain the past record of the $^{13}C/^{12}C$ ratio in the atmosphere by this method, it will require extensive and careful effort.

55492 (PNL—3068) **Collection and analysis of vegetative cover data.** Sauer, R.H.; Owzarski, S.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 30p. Dep. NTIS, PC A03/MF A01.

The rationale, methods, and analytic tools that are commonly used to study changes in vegetation on the Hanford Site are discussed. The method of vegetation analysis that has been successful in the Columbia Basin in Washington State is Daubenmire's (1959) canopy cover approach. Canopy cover is the percent of ground surface covered by a vertical projection to the soil of the outer edges of a plant's live parts. Six classes are recognized in use. The percentage cover of each species present is estimated and placed in one of the six classes. The advantage of placing the cover of a species into broad classes instead of making more accurate estimates is that it allows faster data collection. The error is reduced with many samples (usually 50) because the actual value in some samples will be less than the midpoint, and others, greater than the midpoint. The midpoint value is used to calculate the statistics of canopy cover. A FORTRAN listing of the program cover and sample output, consisting of a data listing, frequency, cover statistics, and species diversity for each line is given in the appendix.

55493 (UCRL—82028) **Global observation of atmospheric ozone by satellite.** Lovill, J.E.; Ellis, J.S.; Weidhaas, P.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jul 1979. Contract W-7405-ENG-48. 7p. (CONF-790842—1). Dep. NTIS, PC A02/MF A01.

From International conference of global atmospheric pollution; Boulder, CO, USA (22 Aug 1979).

In March 1977 infrared radiance data became available from a new series of satellites, the Block 5D Defense Meteorological Satellite Program (DMSP) system operated by the US Air Force. A multichannel filter radiometer (MFR) on the first satellite (F1) began transmitting simultaneous radiance measurements from the channels in the 9.6 μm ozone bands, 15-μm carbon dioxide bands, 18- to 30-μm rotational water vapor band, as well as from the atmospheric window near 12 μm. The sensor provides ozone measurements made with a cross-track scanning instrument. The measurements are made at a high spatial resolution and low noise levels. The infrared MFR sensor made both daytime and nighttime observations, with up to a maximum of 67,500 observations each day. A discussion of the accuracy of these satellite MFR total ozone measurements is given. Comparisons are made against a specially selected network of surface-based total ozone measurement observations, as well as total ozone measurements made by another satellite sensor. A map of satellite measured total ozone is presented and compared against the temperature analysis from radiosonde ascents made during the Southern Hemisphere winter. (JGB)

55494 (UCRL—82556) **Man's effect on stratospheric ozone.** Ellsaesser, H.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 23p. (CONF-790858—2). Dep. NTIS, PC A02/MF A01.

From 4. international symposium on environmental biogeochemistry; Canberra, Australia (27 Aug 1979).

Since McDonald, at the beginning of this decade, first proposed that water vapor from SST exhaust would lead to increases in skin cancer, about a dozen man-induced mechanisms have been suggested as threatening to modify our stratospheric ozone uv-shield. Possible thinning of the ozone layer has been attributed to one or more of the catalytic ozone destroyers, water vapor (HO/sub x/), oxides of nitrogen (NO/sub x/), chlorine (ClX); or bromine (BrX). The original catalyst, HO/sub x/, rather quickly lost its role to NO/sub x/. In an almost unique evolution, computed sensitivity of stratospheric ozone to NO/sub x/ progressively declined until a reversal of effect occurred. Models now compute a thickening of the ozone layer for any but high level or very massive injections of NO/sub x/. Meanwhile, computed sensitivity to ClX has fluctuated widely and in 1978 models increased to the point where comparisons with observations were becoming an embarrassment. The potential role of BrX has also increased but awaits a credible source of stratospheric bromine to bring it center stage. More recently the atmospheric build-up of carbon dioxide, by cooling the stratosphere and increasing the chemical equilibrium level of ozone, has also been recognized as a potential modifier of the ozone layer.

55495 **Conversion of sulfur dioxide to sulfate during the Da Vinci flights.** Forrest, J.; Schwartz, S.E.; Newman, L. (Brookhaven National Lab., Upton, NY). *Atmos. Environ.;* **13**: 157-167(1979).

Simultaneous measurements of atmospheric particulate sulfate and SO_2 were made by tandem filter sampling during manned balloon flights. The balloon permited measurement of chemical species evolution while following a given air mass. On the June 8, 1976, flight, the balloon encountered a relatively stagnant air mass, remaining above St. Louis County for most of the day before being carried off by nocturnal winds. Concentrations of sulfate and SO_2 remained relatively constant during an eight-hour period. Processes responsible for concentration changes were examined to set bounds upon the oxidation rate of SO_2. The data are consistent with an oxidation rate as low as zero and no greater than $4\%h^{-1}$.

55496 **Outdoor sources of indoor air pollution.** Silberstein, S. (Brookhaven National Lab., Upton, NY). *Energy Build.;* **2**: 55-64(1979).

Since it is inadequate to consider pollution levels constant, it is assumed that they follow daily cycles and can thus be well represented by Fourier series. It is concluded that the indoor concentration of any pollutant generated solely outdoors also follows a daily cycle but its maximum lags behind and is lower than the outdoor maximum to an extent depending in an inverse manner on v, the air exchange (ventilation + infiltration) rate. A simple measure of the daily variation of pollutant concentrations and indoor production rates can be derived from their Fourier series and used to test whether these quantities can be assumed constant. Although average daily indoor and outdoor pollutant concentrations of any pollutant are the same if there are no indoor sinks, lowering v will still protect a building's occupant if the outdoor peak or variation above its average is much greater than its average, and the peak is short-lived. Lowering v probably raises indoor average and peak pollutant concentrations from all indoor sources by at least as much as it lowers only peaks from just one outdoor source, rush hour traffic, thus increasing indoor pollutant levels.

55497 **Tropospheric photochemical and photophysical processes.** Pitts, J.N. Jr. (Univ. of California, Riverside); Finlayson-Pitts, B.J. pp 236-258 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Some areas where tunable lasers - ir, uv, and vacuum uv - might play a definitive role in achieving a significantly better understanding of the complex chemical and physical transformations occurring in the natural and polluted troposphere are illustrated. The classical and current mechanisms of photochemical air pollution are discussed briefly. Emphasis is placed on possible applications of tunable lasers to identification and monitoring of: pollutants capable of absorbing solar radiation and producing reactive species in air; atomic and free radical intermediates formed in primary and secondary processes; and the ultimate products of these photooxidations both in simulated and real atmospheres. Those species known or suspected to be present in ambient air which may have significant chemical, physical, or biological effects and for which no satisfactory conventional monitoring techniques now exist are discussed. In addition, the importance of secondary aerosols (particulates) produced by gas-to-particle conversion processes in the polluted troposphere is discussed. It is concluded that there are many important problems to which tunable lasers might be profitably applied. These include: the detection and measurement of molecular species of interest in the real and polluted troposphere, particularly those which are difficult to determine by conventional techniques, for example, hydroperoxides and carcinogens, such as nitrosamines; development or extension of techniques for determining free radical and electronically excited intermediates [e.g., $O_3(^1\Delta/\text{sub g/})$]; application of tunable lasers to the problem of elucidating the mechanisms of the elementary processes and overall chemical reactions involved in tropospheric pollution, including those which may be occurring on surfaces; development of in-situ analytical techniques for better establishing the chemistry of particulates, especially those falling in the size range of 0.1 to 2 μm. (JGB)

55498 Photochemistry in the stratosphere. Johnston, H.S. (Univ. of California, Berkeley). pp 259-278 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

The current understanding of stratospheric photochemistry and dynamics is based partly on direct observations and partly on model calculations. At present it is desirable to increase the ratio of observations to calculations in this subject, although some components of the problem are now well established. Ozone is formed from far ultraviolet solar radiation and oxygen in the middle and upper stratosphere. The local and the global rates of ozone formation can be reliably evaluated. Of the ozone formed below 45 km, 20 to 30 percent is destroyed by ozone itself, 10 to 20 percent is destroyed by free radicals derived from water, and 50 to 70 percent is catalytically destroyed by natural stratospheric oxides of nitrogen. The natural rate of production of stratospheric nitrogen oxides is known, and this source strength provides a simple, general measure of how large man-made pollution of the stratosphere would have to be in order to cause a large reduction of ozone. Current civilian aircraft, current military aircraft, and the proposed 50 space shuttles per year add ozone-destroying catalysts to the stratosphere at a rate much less than their natural formation. A fleet of supersonic, passenger aircraft that would be large enough to pay for its development costs or continuous usage of chlorofluorocarbons at the current rate would each add ozone-destroying catalysts to the stratosphere at about the same rate that nature now produces stratospheric nitrogen oxides. To estimate the magnitude of ozone reduction caused by this approximately doubling of ozone-destroying catalysts, one must turn to the detailed model calculations involving two or three dimensions of atmospheric motions; such computations are quoted here.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54857, 55603, 55615

55499 (PNL—2933) **Environmental status of the Hanford site for CY 1978.** Houston, J.R.; Blumer, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 76p. Dep. NTIS, PC A05/MF A01.

Continued compliance of Hanford operations with all applicable state and federal environmental regulations, with the exception of suspended particulates from several steam power plants, was demonstrated by the environmental and effluent data collected during 1978. Included in the environmental data collected were measurements of external radiation, and radionuclide analyses of air samples, Columbia River water, other surface waters, wildlife, soil, and vegetation. Periodically all roadways, railways, and active as well as retired waste disposal sites were surveyed to detect any abnormal levels of radioactivity.

55500 Review of parameter values used to assess the transport of plutonium, uranium, and thorium in terrestrial food chains. Garten, C.T. Jr. (Oak Ridge National Lab., TN). *Environ. Res.;* **17**: 437-452(1978).

A general methodology of predicting the food chain transport of atmospherically deposited radionuclides is reviewed with an emphasis on variation in the parameter values important for realistic behavioral characterization of environmental releases of plutonium, uranium, and thorium. Parameters important to generic simulations of food chain transport, given a known constant deposition onto vegetation, include: fractional interception of particulates by vegetation, vegetation density, effective half-life of contamination on vegetation, soil-to-plant transfer factors, consumption rates by cattle and man, and transfer of nuclides from forage to meat and from forage to milk. Variation in these parameters, which has been encountered in field studies, is summarized. A partial reduction in the variation of predicted concentrations of actinides in foods can be accomplished by more accurately determining critical parameter values like fractional interception of deposition by vegetation, vegetation biomass, and the effective half-life of contamination on vegetation. Field research describing the site dependency and time dependency of probability density functions for model parameter values is needed to make probabilistic predictions concerning Pu, U, and Th transport in food chains and to reduce the uncertainty associated with model predictions and generic assessments of environmental impact.

55501 Fallout in East Tennessee following Chinese nuclear tests of 1976 to 1978. Shank, K.E.; Oakes, T.W.; Eldridge, J.S. (Oak Ridge National Lab., TN). pp 411-417 of Trace substances in environmental health. XII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1978).

From 12. conference on trace substances; Columbia, MO, USA (5 Jun 1978).

The fallout levels in East Tennessee following the Chinese nuclear tests of 1976 to 1978 are given. The environmental surveillance activities at Oak Ridge National Laboratory are outlined, as well as their integration into the nationwide monitoring network. A method for rapid determination of ^{131}I in milk is described; these levels in milk are highlighted, along with airfilter and rainwater data. Maximum radiological dose commitments, as a result of the recent tests, are presented.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

55502 (ATDL—78/19) **Environmental Research Laboratories 1977 annual report.** (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). Dec 1978. 525p. Dep. NTIS, PC A23/MF A01.

Research is reported in the following subject areas: regional-scale effects of energy generation; mesoscale transport and diffusion modeling; effluent plume behavior; forest meteorology; climatological studies. Current research programs include air transport studies, especially in rough terrain; air pollution studies; the meteorological effects of cooling towers and energy production; research on plume and wake behavior (including effects of buoyancy, active thermal convection, building wake interaction, and removal processes); extension of atmospheric transport, diffusion, and effluent removal models to special situations such as over-water and over-forest flows; and study of the role of forest structure on the atmospheric energy balance and on diffusion. Separate abstracts were prepared for those studies on scope for ERA/EDB. (JGB)

55503 (ATDL—78/19, pp 133-233) **Atmospheric effects of energy generation.** Hanna, S.R. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

The effects of excess heat and moisture released to the atmosphere as the result of energy generation is discussed. Specific methods for estimating effects such as cloud formation or drift deposition are outlined. The cooling tower is the source that is most thoroughly treated.

55504 (ATDL—78/19, pp 248-251) **Model predictions and observations of clouds formed by oil refineries in Los Angeles.** Hanna, S.R. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

Photographs on seven occasions indicate cloud development over Los Angeles oil refineries. The plume and cloud growth model successfully simulated these clouds in about 80% of these cases. In all of the model predictions, the cloud is equivalent in physical characteristics to small to medium size natural clouds. Of course it is possible in the real world for the heat input from oil refineries to trigger natural clouds or to interact with topography or the seabreeze to create large storm clouds; but the simple one-dimensional model used in this work cannot treat these effects. Furthermore, entrainment processes are more complicated in large developing clouds than the simple $\alpha = .3$ assumption used here. The Los Angeles refinery clouds are no more spectacular, either in photographs or in computer model output, than similar clouds photo-

graphed and modeled over power plants and industries in other parts of the country. The conclusions of other investigators that the Los Angeles refineries cause unusually severe phenomena such as hail should be very carefully studied by means of comprehensive field programs.

55505 (ATDL—78/19, pp 418-429) **Numerical study of meteorological effects of waste heat and moisture releases from hypothetical power parks.** Hosker, R.P.; Rao, K.S. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

A two-dimensional nonprecipitating shallow cloud model was developed for the Meteorological Effects of Thermal Energy Releases (METER) program. This second-order-closure turbulence model utilizes a full set of equations for mean wind velocities, potential temperature, specific humidity, and liquid water content, as well as equations for the corresponding turbulent fluxes which are closed approximately. Vapor-liquid water phase changes are included in terms of saturation adjustments. A hypothetical power park was treated as an area source with idealized distributions of waste heat and water vapor fluxes from several cooling towers. These fluxes were utilized as boundary conditions to the model. Numerical experiments were performed for a 10,000 MW(e) power park in a convective atmosphere with variable surface relative humidity and mean wind direction. The total waste heat flux over the power park area was also arbitrarily varied. Preliminary results presented include typical vertical profiles of mean potential temperature, specific humidity, and liquid water in the atmosphere, as well as perturbations in the surface temperature and humidity due to the power park.

55506 (ATDL—78/19, pp 430-469) **Report on ATDL research on meteorological effects of thermal energy releases.** Hanna, S.R.; Rao, K.S.; Hosker, R.P. Dec 1978.

In Environmental Research Laboratories 1977 annual report.

Illustrations are given of applications of the ATDL Plume and Cloud Growth Model to the following facilities: John E. Amos Plant, Los Angeles oil refineries, Chalk Point Plant, and Paradise Plant. Research in the following areas is also reported: secondary motions in cooling tower plumes, analysis of observed plume cross sections at Chalk Point, analysis of satellite photographs of moisture and smoke plumes, and a numerical model of meteorological effects of waste heat and moisture releases from hypothetical power parks.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 55049

REGULATIONS

REFER ALSO TO CITATION(S) 55049, 55053

55507 (CONF-790634—3) **Air pollution impacts of revised new source performance standards for industrial boilers.** Placet, M.; Streets, D.G. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From 72. annual Air Pollution Control Association meeting; Cincinnati, OH, USA (24 Jun 1979).

Since EPA is currently considering a major revision to its strategy for control of emissions from new industrial boilers, a previously reported study was conducted to determine what a variety of new regulatory approaches would buy in terms of pollution reductions. A computerized environmental forecasting model,Strategic Environmental Assessment System (SEAS), was used to estimate changes in emission levels which would result from implementation of a series of six scenarios representing alternative New Source Performance Standards NSPS. A preliminary effort was then made to incorporate the results of long-range environmental trend analysis into the regulatory assessment process. Results of the study indicate that in the industrial fuel combustion sector, increases in sulfur dioxide and nitrogen oxide emissions are projected through 1990 even if the revised NSPS is very strict. Since current State Implementation Plan (SIP) regulations for SO_2 and Nox are not very stringent, little reduction from old sources occurs. Therefore, increases due to additional combustion of coal (and other fuels) are not offset. Implementation of a strict NSPS has the greatest effect on SO_2 emissions. By 1990, industrial combustion is expected to contribute up to approximately 20% of total national SO_2 emissions. In the most stringent scenario, which requires 90% removal of SO_2 on all boilers greater than 10 MM BTU/Hr (through use of SO_2 scrubbers), industrial emissions are reduced almost 20%, lowering national emissions by practically 4% in 1990. The effect of a revised NSPS on NOx emissions is quite small. On the national level, particulate matter decreases due to strict control of new sources and are overshadowed by a drastic decline in emissions from old sources as they comply with State Implementation Plan regulations. If larger reductions in emissions from industrial combustion are desired, emphasis must be placed on sources not stressed in the standards that EPA is considering.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 55469

BASIC STUDIES

55508 **Numerical model for saturated-unsaturated flow in deformable porous media. 2. The algorithm.** Narasimhan, T.N. (Univ. of California, Berkeley); Witherspoon, P.A.; Edwards, A.L. *Water Resour. Res.;* 14: No. 2, 255-261(Apr 1978).

An integrated finite difference algorithm is presented for numerically solving the governing equation of saturated-unsaturated flow in deformable porous media. In recognition that stability of the explicit equation is a local phenomenon a mixed explicit-implicit procedure is used for marching in the time domain. In this scheme the explicit changes in potential are first computed for all elements in the system, after which implicit corrections are made only for those elements for which the stable time step is less than the time step being used. Time step sizes are automatically controlled in order to optimize the number of iterations, to control maximum change in potential during a time step, and to obtain desired outputs. Time derivatives, estimated on the basis of system behavior during two previous time steps, are used to start the iteration process and to evaluate nonlinear coefficients. Boundary conditions and sources can vary with time or with the dependent variable. Input data are organized into convenient blocks. Accuracy of solutions can be affected by modeling errors, different types of truncation errors, and convergence errors. The algorithm constitutes an efficient tool for analyzing linear and nonlinear fluid flow problems in multidimensional heterogeneous porous media with complex geometry. An important limitation is that the model cannot conveniently handle arbitrary anisotropy and other general tensorial quantities.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 55525, 55591

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54065, 54073, 55484, 55485, 55492, 55637

55509 **Sulfur distribution and cycling in a deciduous forest watershed.** Shriner, D.S.; Henderson, G.S. *J. Environ. Qual.;* 7: No. 3, 392-397(1978).

Sulfate sulfur concentrations and pH of precipitation and streamflow, and sulfur concentrations of biomass and soil components, were determined for a 97.5-ha mixed deciduous forest (Walker Branch Watershed) in eastern Tennessee. Amounts of sulfur (S) added by precipitation and lost by streamflow were compared to fluxes of S between biomass pools. Approximately 18.1 kg/ha per year entered the watershed from the atmosphere, while only 11.5 kg/ha per year were lost in streamflow. Analysis of biomass and soil concentrations of S indicate that, of the 6.6 kg/ha per year apparent accumulation of S for the watershed as a whole, 8.6 kg accrue to mineral soil while 4.3 kg are lost from organic soil horizons, and 2.3 kg accrue to annual increment of vegetation. Seasonal variations in S input and export from the watershed were closely tied to precipitation events. The weighted mean pH of the rainfall samples collected at five sampling sites on the watershed was pH 4.2. Sulfate accounts for 80% of major anions (millequivalent basis) contributed to the watershed. The behavior of S on Walker Branch Watershed appears to differ significantly from locations in the northeastern US, however the data suggest active expansion to the southeastern US of the area impacted by atmospheric sulfate pollution commonly associated with the northeastern region of the US.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54242, 55499

55510 (UCID—18259-78) **FY 1978 annual technical report of Lawrence Livermore Laboratory's participation in the DOE-NV proj-**

ect: Radionuclide Migration in the Ground. Ramspott, L.D.; Tewhey, J.D.; Coles, D.G.; Weed, H.C.; Schweiger, J.S.; Stone, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Aug 1979. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

Activities by the Lawrence Livermore Laboratory in support of the Department of Energy, Nevada Operations Office for the Radionuclide Migration in the Ground (RNM) program include: laboratory study of single-pass leaching of nuclear melt glass by Nevada Test Site (NTS) groundwater; design of field and laboratory distillation apparatus to concentrate water samples in order to detect low levels of radionuclides; feasibility studies for in situ tracer studies at the Nevada Test Site; periodic sampling and analysis of water from sites of NTS nuclear tests; and, geochemical studies of melt glass from NTS underground nuclear tests. The results for these activities are described.

SOIL

REFER ALSO TO CITATION(S) 54243

55511 (EGG—1183-1659) **Aerial radiological survey of the area surrounding the Monticello and Elk River Nuclear Power Plants (Monticello and Elk River, Minnesota). Date of survey: May 1972.** Boyns, P.K. (EG and G, Inc., Las Vegas, NV (USA)). Jan 1977. Contract EY-76-C-08-1183. 28p. Dep. NTIS, PC A03/MF A01.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Monticello and Elk River Nuclear Stations during May 1972. The survey measured terrestrial gamma-ray exposure rate and spectral data. A high-sensitivity detection system collected gamma-ray spectral and gross count data. The data were then processed to construct a map of a 625-square-mile area showing the spatial distribution of gamma-ray exposure rates 3 feet above the ground. Exposure rates and isotopes identified are consistent with that related to normal terrestrial background radiation. The first survey of the Elk River area was conducted in September 1968; however, the Elk River reactor has been shut down since 1968. The first Monticello survey conducted in August 1970 also covers the Elk River reactor area. The two reactors are approximately ten miles apart. Comparison of the 1970 and 1972 Monticello survey data shows no measurable change in the terrestrial gamma exposure rate in the intervening years, due to the Monticello Reactor operations or the shutdown and dismantling of the Elk River Reactor.

55512 (EGG—1183-1699) **Aerial radiological survey of the Duane Arnold Energy Center (Palo, Iowa). Date of Survey: June 1976.** (EG and G, Inc., Las Vegas, NV (USA)). Feb 1977. Contract EY-76-C-08-1183. 18p. Dep. NTIS, PC A02/MF A01.

An airborne radiological survey of an 2146 km^2 area surrounding the Duane Arnold Energy Center was made between June 3 to 7, 1976. Detected radioisotopes and their associated gamma ray exposure rates were consistent with that expected from the normal background emitters. Areal average exposure rates equivalent to one meter above the ground are presented in the form of an isopleth map. Exposure rates measured with small portable instruments and soil sample analysis showed excellent agreement with the airborne data. Geological data are presented in an isopleth map of rock and soil types; a brief description of the vegetation and terrain surrounding the site is also included.

55513 (IDO—12087, pp 194-199) **Revegetation following a 1974 fire at the Idaho National Engineering Laboratory Site.** Fraley, L. Jr. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Fire destroyed the existing vegetation on 3 km^2 on the INEL Site in September 1974. Vegetation data collected during the next two growing seasons indicated an initiation of secondary succession. Annuals, primarily Salsoli kali and Halogeton glomeratus, invaded the burned area and comprised most of the biomass in the second growing season. There was a significant decrease in vegetation and litter cover the first growing season and an incrase in each in the second growing season as a result of the annuals. The diversity returned to normal by the second growing season but the plant community was still different and is expected to remain different for several years because of the predicted slow recovery to an Artemisia dominated community.

55514 (LA—7874-PR) **Environmental and radiological safety studies: interaction of $^{238}PuO_2$ heat sources with terrestrial and aquatic environments. Quarterly progress report, January 1-March 31, 1979.** Waterbury, G.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jun 1979. Contract W-7405-ENG-36. 41p. Dep. NTIS, PC A03/MF A01.

The containers for $^{238}PuO_2$ heat sources in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with earth and safely contain the nuclear fuel until it is recovered. Existing designs have proved more than adequately safe, but more information about the heat sources is needed in order to improve their safety. The work discussed here includes studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems. The data obtained in several ongoing experiments are presented; these data tables will be updated quarterly. Compilations of usable data generated in each experiment are emphasized. These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO_2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 55500, 55516, 55517, 55518, 55519, 55605, 55609, 55614

55515 (IDO—12087, pp 224-235) **Ecology of sage grouse on the Idaho National Engineering Laboratory Site.** Connelly, J.W.; Ball, I.J. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

A comprehensive study of the sage grouse ecology was initiated on the INEL Site in 1977. Objectives include documentation of radionuclide concentrations, population size, habitat use, and movement patterns of sage grouse on the Site. Sixteen grouse have been collected and radionuclide concentrations determined. Only part of the Site and surrounding area have been adequately searched for strutting grounds (leks), but 32 have been located to date. Trapping success has been strongly influenced by weather conditions and by the season; 121 sage grouse have been captured, banded, and color- and radio-marked.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 55055, 55513, 55515, 55600

55516 (IDO—12087) **Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.** Markham, O.D. (ed.). (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1978. Contract W-7405-ENG-82. 380p. Dep. NTIS, PC A17/MF A01.

Separate abstracts were prepared for the 33 papers presented in this report. Two additional abstracts are included dealing with the seasonality of shrub litterfall and interpretation of Idaho National Environmental Research Park functions and activities. Publications and oral presentations originating with the personnel of the radioecological program and the National Environmental Research Park are listed. (ERB)

55517 (IDO—12087, pp 67-73) **Dispersal and density of small mammals on the radioactive waste management complex Idaho National Engineering Laboratory Site.** Keller, B.L. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

In April 1978 a study of small mammal density, species composition, and dispersal patterns for the Radioactive Waste Management Complex was initiated. This study will provide data necessary to determine the role of small mammals in the redistribution of transuranics and other radionuclides and the amounts being moved. The problems associated with studying dispersal of rodents from the SDA are discussed.

55518 (IDO—12087, pp 74-92) **Ecology studies at the Idaho National Engineering Laboratory Radioactive Waste Management Complex.** Arthur, W.J.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

In September 1977 a radioecological research program was initiated at the Idaho National Engineering Laboratory (INEL) Radioactive Waste Management Complex in the southcentral Idaho. The primary goals of the research are to: (1) determine floral and faunal composition in the area; (2) sample various ecosystem components for radionuclides; (3) determine impacts of small mammal burrowing and vegetation growth on movement of radioactive materials; (4) compare ambient radiation exposures to radiation doses received by animals inhabiting the area; and (5) understand the interrelationships between the organisms and their role in radionuclide transport.

55519 (IDO—12087, pp 93-98) **Home range and local movement of small mammals on the Radioactive Waste Management Complex Idaho National Engineering Laboratory Site.** Groves, C.R. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

In April 1978, a study of local movement of small mammals on the Subsurface Disposal Area (SDA) of the Radioactive Waste Management Complex (RWMC) was undertaken in conjunction with a study of rodent dispersal. Live trapping in May and June revealed a strong potential for the detection of local movement of at least four species of rodents. Information on this movement is important as each species, during burrowing, may transport radioactive waste from the point of interment to the surface. The area over which contamination may be spread, as fecal deposits or as metabolically incorporated elements, is a function of the daily movement of each animal. At least eight factors may effect size and shape of home range. These factors are discussed, techniques employed in the calculation of home range are outlined, and problems associated with live trapping and studying local movement of small mammals are considered.

55520 (IDO—12087, pp 129-143) **Flora of the Idaho National Engineering Laboratory Site.** Jeppson, R.J.; Holte, K.E. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The Idaho National Engineering Laboratory Site (INEL Site) became a National Environmental Research Park in 1975. An increased number of ecological studies in the area created a need for an accurate plant species list and a reference collection of the plants found within the vicinity of the INEL Site. Three plant collections were established to meet the needs of the investigators conducting the different studies. Two collections, a reference and a teaching collection, are housed on the INEL Site at the Radiological and Environmental Sciences Laboratory. The third collection is housed in the Idaho Museum of Natural History, Ray J. Davis Herbarium at Idaho State University in Pocatello, Idaho. The plant species list complied from these collections includes 389 species representing 213 genera and 56 botanical families.

55521 (IDO—12087, pp 144-166) **Trends in vegetation development on the Idaho National Engineering Laboratory Site.** Anderson, J.E.; Jeppson, R.J.; Wilkosz, R.J.; Marlette, G.M.; Holte, K.E. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Data from two permanent vegetation transects that bisect the Idaho National Engineering Laboratory Site were analyzed to determine what changes had taken place in the vegetation community over the past decade and to compare trends in vegetation development on grazed and non-grazed areas. On non-grazed areas, cover and density of four perennial grass species increased significantly. Cover of species within the Agropyron complex also increased significantly. No significant changes in density or cover of the dominant shrubs were observed in either grazed or non-grazed areas. Cover of Stipa comata and Oryzopsis hymenbides increased on areas that are open to cattle grazing, but cover of the other dominant grasses did not change significantly on those areas. The only area that did not show a significant increase in perennial grass cover was the area subject to grazing by sheep. Decreases in cover and density of Agropyron spicatum suggest a deterioration of range condition on this area. Vegetation development on the INEL site since 1950 has not followed an orderly or predictable pattern. The data seem to be more consistent with the relative stability/vegetation development concepts than with classical successional theory. Similar analyses for 1950 and 1957 data are in progress and these additional data will be used to determine vegetative changes on the INEL Site for the past 25 years.

55522 (IDO—12087, pp 171-188) **Response of native vertebrate populations to different land management practices on the Idaho National Engineering Laboratory Site.** Reynolds, T.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Levels of native vertebrate populations were examined in grazed and ungrazed habitats dominated by sagebrush and crested wheatgrass on the Idaho National Engineering Laboratory Site from July 1975 to December 1977. Grazing by sheep did not significantly alter the species diversity or the density of birds nesting in a sagebrush habitat. However, the species diversity and the relative density of small mammals were reduecd. The relative denstiy of the sagebrush lizard was also less in a grazed than in an ungrazed sagebrush habitat, although the relative density of the short-horned lizard was higher in the grazed sagebrush area. Crested wheatgrass plantings supported fewer nesting species and fewer individual birds than did sagebrush areas. The species diversity of mammals, and the relative density of both mammals and reptiles was significantly reduced in areas reseeded with crested wheatgrass. The synergistic effect of planting with crested wheatgrass followed by grazing by sheep was most evident in (1) a significant reduction in the relative density of small mammals, and (2) the occurrence of only one nesting bird species: the Horned Lark.

55523 (IDO—12087, pp 189-193) **Population dynamics and succession in crested wheatgrass stands on the INEL National Environmental Research Park.** Marlette, G.; Anderson, J.E. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Crested wheatgrass is the most common and widely used grass for range rehabilitation. Oil shale and coal strip mining projects frequently seed crested wheatgrass has many desirable characteristics and is especially well adapted for livestock forage in sagebrush communities. Consequently, large areas of native vegetation have been replaced with crested wheatgrass stands. Recent studies suggest that the stable crested wheatgrass monocultures are detrimental to most wildlife species. This study will attempt to identify the factors that influence the stability of crested wheatgrass seedings and the management practices that encourage the development of diverse, native plant communities.

55524 (IDO—12087, pp 200-206) **Repopulation and food habits of small mammals on a burned sagebrush desert.** Halford, D.K. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Transects for small mammal trapping were established on burned and control areas following a fire in Spetember 1974. Trapping was conducted during October 1975 and May 1976 with Museum Special snap traps. The white-footed deer mouse (Peromyscus maniculatus) comprised 87% of the total catch. Although the numbers of rodents captured in the burned area were higher in May than October, only 10% of the captures were from the burn transects. Food habits analyses of deer mice collected in May 1976 indicated that insects contributed over 90% of the diet in both the burn and control areas. The diets of deer mice from both areas had low diversity indices indicating a heavy reliance on a few food items. The diets of rodent populations in control and burn areas were significantly different for all food items analyzed. Comparisons of diets by sex and age within and between burn and control samples were also significantly different in the majority of cases.

55525 (IDO—12087, pp 209-218) **Paleontology of the Idaho National Engineering Laboratory Site.** Bright, R.C.; Davis, O.K.; Eikum, B.K. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The primary purposes of our 1977 study were to (1) inventory fossil deposits at the Idaho Naional Engineering Laboratory (INEL) Site and (2) to begin reconstruction of the natural history of the area using fossils discovered during the survey. The Paleozoic sediments at the northwest end of the site produced no fossils of special interest. However, Quaternary (Ice Age) and Holocene sediments contained freshwater and land snails, freshwater, diatoms, sponge spicules, phytoliths, seeds, and some pollen. Woodrat middens near East Butte contained abundant remains of plant species presently growing on the site. Likewise, the vertebrate fossils from a lava tube near East Butte represent species living in southern Idaho today. A ^{14}C date on snail shells from bar deposits south of Test Area North (TAN) indicates that Lake Terreton has filled within the last 1,000 years. A cave formed from a collapsed lava tube, located just southeast of Experimental Breeder Reactor II (EBR II), was determined to be a potential fossil mammal site and worthy of further study.

55526 (IDO—12087, pp 219-223) **Pronghorn antelope use ofthe INEL National Environmental Research Park.** Reynolds, T.D.; Rose, F.L. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Winter aerial and ground surveys indicate that between 4500 and 6000 pronghorn antelope used the Idaho National Engineering Laboratory (INEL) Site during 1977-1978 winter. Antelope wintered in four separate areas for varying lengths of time. A radiotelemetry study has been initiated to (1) document pronghorn migration routes and timing to and from mountain valleys adjacent to the Site (2) locate winter ranges, and (3) determine seasonal use of the INEL Site by resident and migratory pronghorn. Radio-tracking will continue through December 1979. the vegetal composition of winter ranges will be determined, and the similarities and differences of the plant communities among winter ranges on the INEL Site will be compared.

55527 (IDO—12087, pp 236-247) **Behavioral study of 24-hour activity patterns in coyotes.** Laundre, J.W.; Keller, B.L. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

During 1977, data were collected on daily activity and home range size of coyotes on the INEL Site. Activity expressed in terms of daily travel distances for males and females varied seasonally. Males traveled most extensively during late winter and early spring while female activity peaked during late spring and early summer. Home range size for males and females did not differ significantly.

However, during winter females exhibited a reduction in home range size. The seasonal changes noted in coyote activity and home range size were postulated to be related to the reproductive cycle of coyotes.

55528 (IDO—12087, pp 248-254) **Coyote habitat preferences on the Idaho National Engineering Laboratory Site in southeastern Idaho.** Wilkosz, R.J.; Anderson, J.E. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Recent radiotelemetry data has shown that coyotes on the Idaho National Engineering Laboratory Site use certain areas of their home range more intensively than others and that these areas can be identified as hunting areas and resting areas. We propose to describe the vegetal and topographic components of known coyote hunting and resting areas to ascertain whether hunting or resting is associated with particular vegetation types, components of vegetation, or topographic features. Vegetation of hunting and resting areas will be sampled with a 0.2 x 0.5 m rectangular sampling frame; percent cover of each species and height of each shrub species will be recorded. Aspect, percent slope, texture of substrate and distance from known water will also be recorded for each hunting and resting area sampled. Adult coyote home ranges within the protected areas of the INEL Site will be sampled (the protected area is closed to grazing and predator control). Any correlations found will be related to established schemes of plant community classification for southeastern Idaho.

55529 (IDO—12087, pp 255-264) **Seasonal diets of coyotes on the INEL Site.** Hansen, R.M.; MacCracken, J.G. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The monitoring of coyote food habits started in July 1975 and will probably continue until jackrabbit densities have reached a peak and have declined to the low levels which existed from 1972 through 1976. Coyote food habits from July 1975 to July 1977 were similar between study areas which received low to high use by coyotes. Coyote diet preferences were similar where coyote control and livestock grazing were allowed and where coyote control and livestock grazing were prohibited. The rate of defecation by coyotes was about twice as high in the central part of the INEL Site where coyotes were not controlled as in the periphery where coyotes were hunted and controlled. This may be due to the abundance of rabbits in the central area vs the effects of coyote control. Rabbits made up about 40% and montane voles 16% of the coyote's diet at the INEL Site. During this period jackrabbits made up only 3.4% of the coyote's foods. The means and standard deviations of prey taxa which are alternatives to jackrabbits during low jackrabbit density years were estimated for coyotes at the INEL Site.

55530 (IDO—12087, pp 265-282) **Ecology of the short-horned lizard (Phrynosoma douglassi) and the sagebrush lizard (Sceloporus graciosus) on the INEL Site.** Guyer, C. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The ecology of the short-horned lizard and the sagebrush lizard was studied from June 6 to October 9, 1976 and from April 12 to October 9, 1977. Three age groups were distinguishable in both species: young of the year, juveniles, and adults. Both species maintained populations of 14 to 16 individuals on a 1 ha grid system during the two study years. Survival of juveniles was low (0.15) in shorthorned lizards and high (0.80) in sagebrush lizards. Adult survival was high in both species (0.67 for short-horned and 0.64 for sagebrush lizards). Adults of both species were active from late April to late August. Juvenile short-horned lizards were active from late April to early September, whereas juvenile sagebrush lizards were active from late May to early September. Young of the year appeared during early to mid August and were active until late September. The daily activity pattern of adult and juvenile shorthorned lizards was uniform, whereas sagebrush lizards were unimodal with peak activity from 1100 to 1500 hours. Cloacal temperatures for short-horned lizards increased during morning hours, remained relatively stable during midday hours, and decreased during evening hours. Cloacal temperatures of sagebrush lizards remained relatively constant throughout the daylight hours. Movements of both species were restricted to home ranges. Both species were able to orient to the home range if displaced. Orientation ability and return success was greater in adult than juvenile sagebrush lizards. Both species preferred big sagebrush vegetation within the home range.

55531 (IDO—12087, pp 283-304) **Ecology of burrowing owls on the Idaho National Engineering Laboratory Site.** Gleason, R.S. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Population densities of burrowing owls were low on the sagebrush dominated Idaho National Engineering Laboratory (INEL) Site, and slightly higher in an adjacent agricultural area. Because of scarcity of burrows, cavities in basalt outcroppings were used as nest sites by some pairs. The principal limiting factor to the population appeared to be nest site availability, although scarcity of shrubless areas may have also been important. Diet varied with year, season, and location of nest site. Invertebrates were the most frequently taken prey group, but in terms of biomass contributed to the diet, rodents were the most important prey. Brood size, rodent densities, and the proportion of rodents in the diet varied between years, and between agricultural and nonagricultural areas. The data suggest that availability of rodents was an important regulator of brood size, probably through post-hatching mortality.

55532 (IDO—12087, pp 305-316) **Analysis of pygmy rabbit populations on the Idaho National Engineering Laboratory Site.** Wilde, D.B.; Keller, B.L. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

From January 1975 to January 1978, pygmy rabbits were live trapped at several locations on the INEL Site. Additional specimens were collected at other locations for a necropsy analysis of reproduction. Reproduction was initiated in December and appeared to be related to change in photoperiod in males but green vegetation in females. Three cohorts were produced during the 1976 and 1977 breeding seasons, but the time sequence differed between years. Young were born a month earlier in 1977 and grew more slowly than in 1976. Third litter young were consistently smaller than earlier litters. Survival was lowest in adult rabbits during the winter months of 1976, but was poor during the entire breeding season of 1977. Juvenile survival differed significantly between cohorts and years and appeared to be associated with drought conditions. The potential for rapid expansion of the population associated with most leporids does not seem to apply to pygmy rabbits. Scat analysis indicated sagebrush was the principal food plant foraged. Grass and forb utilization increased during the summer. Burrows were used primarily during winter, were located principally on slopes and valley floor areas, and appeared to be associated with soil deposits produced by prevailing wind patterns.

55533 (ORNL/TM—6803/51) **White-tailed deer (Odocoileus virginianus) on the Department of Energy's Oak Ridge Reservation Supplement 1: 1978 status report.** Kitchings, J.T.; Story, J.D. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

During 1978 forty-five white-tailed deer (Odocoileus virginianus) were killed by vehicles on the Department of Energy's Oak Ridge Reservation. Patterns of mortality were similar to those previously reported for a nine-year period (1969-1977). During the year the highest number of deer were killed in the fall and more males than females were killed among both fawns and adults. The forty-five deer killed in 1978 are fewer than would have been predicted by the annual rate of increase in the number of road-killed deer during the nine-year base period (1969-1977). This is attributed to both the Tennessee Wildlife Resources Agency's trap-removal program and to a greater degree of driver awareness to the possibility for hitting an animal. Habitat usage studies were initiated during 1978 by radio-collaring three animals, one buck and two does. Preliminary analysis indicated that the buck showed no preference for a particular habitat. The two does showed a preference for lowland hardwood and pine-dominated areas.

55534 (PNL—2821) **Effects of the Ben Franklin Dam on the Hanford Site.** Harty, H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 230p. Dep. NTIS, PC A11/MF A01.

A previous assessment of the effects of a Ben Franklin Dam on the Hanford Site made in 1967 was updated so that the potential adverse effects may be better understood in light of existing operations, current environmental and safety standards, and proposed facilities and operations. The major effects would probably arise from flooding of portions of the site by the reservoir associated with the dam and by the raising of the ground water table under the site. A preliminary analysis of the effects of the dam is presented, and a number of studies are recommended in order to fully evaluate and understand these potential impacts. The following seven tasks are identified and discussed: groundwater - hydrology analysis; soil liquefaction analysis; hydrostatic uplift and soil effects on structures; assessment of the potential for landsliding and sloughing; facility decommissioning; hydrothermal analysis; and, meteorological effects. Four other aspects commented upon in this report are: aquatic ecology, terrestrial ecology, socioeconomic effects, and public interaction. Possible effects on ongoing DOE-sponsored R and D are also noted. To the extent possible, cost estimates are developed for corrective actions which must be taken on the Hanford Site to accommodate the dam. Where this was not possible, appropriate courses of action leading to cost estimates are presented.

55535 **Call for information on coastal energy facility siting: an analysis of responses.** Trenton, NJ; New Jersey Department of Environmental Protection (1977). 57p. (NP—23942). Office of Coastal Zone Management, Trenton, NJ.

The Call for Information issued by the New Jersey Department of Environmental Protection in December 1975 consisted of an eight page questionnaire which was sent to industries, government agencies, and private organizations. Its objective was to seek the help of these groups in plans for the siting of energy facilities in the coastal zone. Potential development of oil and gas from the Baltimore Canyon region adjacent to New Jersey has made planning for energy facilities a priority issue both at the state and federal level. The Call for Information invited government and the energy industry to submit (a) suggested criteria for locating energy and energy-related facilities within the New Jersey coastal zone, (b) analyses by governmental and private agencies or groups of the need to locate energy facilities in specific sites within New Jersey's coastal zone, or in generalized portions thereof, and (c) identification of the land-use parameters, appropriate to the various types of facilities which may be proposed, now or later, for coastal siting. The findings obtained from the draft call and the final call issued seven months later are presented. The results of the industries' responses show that the electric and gas utilities gave some useful information while this was true of only a few of the oil companies. The reluctance to give information was perhaps aggravated by lack of clear state and federal policies. The appendices illustrate specific information on manpower, cost and facility requirements to develop oil refineries, establish a gas processing plant as well as information from the US Coast Guard and the Environmental Protection Agency. There is also a listing of the companies that bid in the August 1976 lease sale indicating which bids were accepted, a map of the offshore tracts, and a list of which companies responded to the Call for Information.

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 55469

BASIC STUDIES

55536 (EGG—1183-1702) **Snow water equivalent survey of the Souris River Basin. Date of survey: March 1976.** Fritzsche, A.E. (EG and G, Inc., Las Vegas, NV (USA)). Jan 1977. Contract EY-76-C-08-1183. 48p. Dep. NTIS, PC A03/MF A01.

The accumulation of a large snow pack in the Souris River Basin in Saskatchewan and North Dakota dictated the need to obtain as much water equivalent of snow (WE) information as reasonable. This WE information could then be used by Kansas City River Forecast Center and the Bismarck, North Dakota Weather Service Forecast Office to forecast the Souris River peak flows and flood levels. These data are also vital to the Canadian Department of Environment who must forecast the effects of the snow runoff along those portions of the Souris River in Canada. For this reason the newly assembled RAMS (Remote Airborne Measurement of Snow), operated by EG and G, Incorporated, Las Vegas, Nevada, was deployed to Minot, North Dakota to conduct the survey during March 22-26, 1976 during the snow melt season. Tables are presented to show photopeak count rates and water equivalent results from the Saskatchewan and northern North Dakota survey lines. Qualitatively the airborne results were good for the North Dakota lines. Good agreement with the ground based data was achieved. The airborne system appeared to underestimate the WE for the Canadian lines because of rapid and dynamic melting conditions that were in progress.

55537 **Persistent blooms of surf diatoms along the northwest coast.** Lewin, J. pp 81-92 of Marine plant biomass of the Pacific Northwest Coast. Krauss, R. (ed.). Corvallis, OR; Oregon State University Press (1978).

Along the sandy beaches from Tillamook Head in Oregon to Point Greenville, Washington, algal growth in the form of surf diatoms is present. It is so dense that the breaking waves are brown and thick with deposits. These diatom blooms have two unique features: (1) there are only 2 species comprising the blooms (Chaetoceros armatum T. West and Asterionella socialis Lewis and Norris), and (2) they are persistently present and most abundant during autumn, winter, and early spring. Their population concentrations, environmental factors, nutritional aspects, and interdependence with the razor clam are discussed.

55538 **Studies of delta-aminolevulinic acid dehydrase from Skeletonema costatum, a marine plankton diatom.** Owens, T.G. (Brookhaven National Lab., Upton, NY); Riper, D.M.; Falkowski, P.G. Contract EY-76-C-02-0016. *Plant Physiol., Suppl.;* **62**: 516-521(1978).

The accumulation of δ-aminolevulinic acid and activities of δ-aminolevulinic acid dehydrase were examined in the marine diatom, Skeletonema costatum, grown in the presence of levulinic acid. Levulinic acid concentrations greater than 10 mM affect growth and morphology, and inhibit chlorophyll synthesis. The algae recover from the effects of levulinic acid after 48 hours of exposure. The recovery is characterized by increased cellular cholorphyll content, decreased δ-aminolevulinic acid accumulation, decreased 3-(3,4-dichlorophenyl)-1,1-dimethylurea-enhanced in vivo fluorescence, and the induction of a levulinic acid-activated δ-aminolevulinic acid dehydrase which does not follow Michaelis-Menten kinetics. The data indicate that levulinic acid blocks may be ineffective in vivo, and that δ-aminolevulinic acid is metabolized to amino and dicarboxylic acids. δ-Aminolevulinic acid dehydrase activities are used to estimate the capacity for chlorophyll synthesis. Results suggest this diatom may be capable of rapid chlorophyll turnover, which would allow the plant to light-shade adapt on the time scales appropriate to vertical mixing rates in the sea.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 55591

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54073, 54148, 54150, 54151, 54182, 55484, 55485, 55486, 55492, 55509, 55576, 55635

55539 (LBL—9277) **X-ray absorption spectroscopy for the chemical characterization of atmospheric aerosols.** Jaklevic, J.M.; Thompson, A.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 7p. (CONF-791103—2). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The study was performed using a high-resolution monochromator x-ray beam designed for scanning x-ray absorption measurements. In view of the relatively low concentrations of the elements under study, a special fluorescence technique using semiconductor x-ray detectors was employed for the measurement of the x-ray cross sections. Measurements were made on the elements V, Mn, Fe, Cu, Zn and Pb on both urban aerosol samples and on fly ash samples obtained from power plant stacks and plumes. Ambient air samples collected from urban St. Louis were analyzed for the chemical composition of Fe, Zn, and Cu compounds. Data were obtained separately for the fine and coarse particle fractions collected by dichotomous samplers. In general, the fine particles (< 2.4 μm) were found to be in the sulfate form consistent with most results in areas where the particulate chemistry is dominated by the presence of SO_2 from power plants. The coarse particles were either oxide, sulfates, or mixtures of the two. This is true even for samples obtained at the same site and sampling time but representing fine and coarse particle fractions. This difference in chemical composition reflects the assumed differences in origin of particles in the two size ranges. Major elements present in fly ash samples obtained both in-stack and from plume samples were analyzed. Attempts were made to discover any differences in chemical form for the elements as a function of particle size within the stack samples or as a function of residence time in the plume. At the present time, the data are inconclusive due to the poor statistics associated with individual measurements. As more data are acquired and more sophisticated analysis methods are employed, it is presumed that unique chemical assignments will be made. On the basis of the results available thus far, the potential for employing x-ray absorption fine structure analyses to the problem of characterization of aerosol samples was demonstrated.

55540 (SRO—0890-T2) **Geochemical aspects of atmospherically transported trace metals over the Georgia Bight.** Mullins, B.M. (Georgia Inst. of Tech., Atlanta (USA)). May 1978. Contract EY-76-S-09-0890. 75p. Dep. NTIS, PC A04/MF A01.

Thesis.

There has been considerable evidence in recent years that a significant portion of the trace metals reaching coastal waters are transported by the atmosphere. The present study had the following three purposes: to assess trace metal concentrations and enrichment factors in the nearshore atmosphere over the Georgia Bight between Charleston, South Carolina and Jacksonville, Florida; to determine the sources of the metals; and to evaluate the solubilities of some of the metals in seawater. Atmospheric trace metal concentrations and enrichment factors generally decrease from Charleston to Jacksonville. Five metals (Cd, Zn, Cu, Ni, and Pb), were found to be anomalously enriched over the Georgia Bight. Observations from this study suggest that seawater may influence Cu and Zn concentrations in Georgia Bight air. Solubilities of Zn and Cu in seawater are source dependent, as seen by correlation with EF/sub crust/. No significant solubility of Ni in seawater was observed. Yearly fluxes of eight trace metals from atmosphere to seawater in the Georgia Bight were estimated. These trace metal fluxes are comparable to fluxes in other areas along the east coast. The fluxes of Cu, Cd, and Zn make

considerable contributions to dissolved metal levels in Georgia Bight water. An attempt to use trace metal concentrations in Spanish mosses as a means of tracing sources of trace metals over the Georgia bight was inconclusive.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 55499

WATER

REFER ALSO TO CITATION(S) 54237, 55638

55541 (DP—1528) **Cesium transport in Four Mile Creek of the Savannah River Plant.** Kiser, D.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1979. Contract EY-76-C-09-0001. 22p. Dep. NTIS, PC A02/MF A01.

The behavior of a large radioactive cesium release to a Savannah River Plant (SRP) stream was examined using a stable cesium release to Four Mile Creek. Measurements following the release show that most of the cesium released was transported downstream; however, sorption and desorption decreased the maximum concentration and increased the travel time and duration, relative to a dye tracer, at sampling stations downstream. The study was made possible by the development of an analytical technique using ammonium molybdophosphate and neutron activation that permitted the measurement of stable cesium concentrations as low as 0.2 μg/L.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 55516, 55545, 55609, 55610, 55611

55542 (IDO—12087, pp 15-27) **Transuranic concentrations in selected biotic and abiotic components of the Idaho National Engineering Laboratory Test Reactor Area ponds.** Kuzo, G.B.; Fraley, L. Jr.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The TRA leaching pond area was sampled from June through August 1976 and again in 1977 to determine the concentration of five transuranic radionuclides, Pu-238, Pu-239, Am-241, Cm-242, and Cm-244, in abiotic and biotic components of this freshwater ecosystem. Highest concentration ratios were obtained for periphytic, planktonic, and sediment components of the system. Concentrations of these radionuclides decreased with increasing trophic level organisms, i.e., aquatic insects and bird species. Plant species analyzed had concentration ratios of approximately one to two orders of magnitude. These data represent the first investigation of five transuranic radionuclides being concurrently studied within a single freshwater ecosystem. The complete transuranic inventory will be combined with limnological data to compare the distribution of these nuclides with data obtained from other freshwater systems. From these comparisons, models concerning the movement of the radionuclides within and away from a freshwater system will be developed.

55543 (IDO—12087, pp 28-46) **Gamma emitting radionuclides of the Test Reactor Area leaching ponds.** Millard, J.B.; Whicker, F.W.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Radioactive leaching ponds adjacent to the Test Reactor Area (TRA) located on the Idaho National Engineering Laboratory (INEL) Site were investigated to determine the seasonal distribution and ecological behavior of gamma emitting radionuclides. The potential hazards to man and the environment were considered through the biological export of radioactive materials from the ponds. Both biotic and abiotic pond compartments were sampled. Fall and winter biomass estimates showed that benthic periphyton comprised 52%, macrophytes and littoral vegetation 35%, and seston 10% of the total for all biotic compartments. Concentrations and concentration factors (CFs) for fall and winter are presented for Cr-51, Co-60, Zr-95, I-131, Cs-137, Ba-140, and Ce-141. Concentrations and CFs ranged over seven orders of magnitude for the various nuclides and compartments. Seston and zooplankton had the highest concentrations followed by periphyton, sediment, macrophytes, littoral plants, willow, and filtered water. Arthropods had variable concentrations and CFs. Significant seasonal differences were observed for concentrations and CFs in seston, macrophytes, and littoral vegetation. A compartmental inventory of total gamma emitting activity accounted for 254 Ci (9.25 TBq) of the 731 Ci (24.8 TBq) estimated to remain in the ponds at the time of sampling. Filtered water and surface sediments contained 99% of the total radioactivity, while periphyton and seston had most of the remaining 1%. An estimate of the avian export rate of radioactivity from the TRA ponds showed that potentially harvestable mourning doves had the lowest rate with 0.02 μCi/y. External tissues of migratory waterfowl were found to contribute 90% of the total exported activity for all birds. The total avian export rate was estimated to be 1350 μCi/y during 1975.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 55616, 55617

55544 (DOE-tr—189) **Waste heat project - Upper Rhine area. First semiannual report, 1977.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). Aug 1977. Translation source information not available. 97p. Dep. NTIS, PC A05/MF A01.

The waste heat project for the Upper Rhine area was initiated in order to analyze the relationships between weather phenomena and heat emissions, and in order to draw conclusions from this for planning purposes. It consists of the following component projects: Component Project 1 - setting up a waste heat register for the Upper Rhine area; Component Project 2 - climatological and small-scale aerological studies in the Upper Rhine area; Component Project 3 - analysis of climatological fluctuations for the Upper Rhine area; Component Project 4 - meteorological simulation models; and Component Project 5 - estimate of consequences of waste heat emission in the Upper Rhine area. Special emphasis is placed on the methods of analysis, measurement, model theory, and estimation of consequences, some of which are already being applied and some still to be developed.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 55055, 55516, 55576, 55616

55545 (IDO—12087, pp 317-327) **Summary of the Big Lost River fish study on the Idaho National Engineering Laboratory Site.** Overton, C.K.; Johnson, D.W. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Winter fish mortality and fish migration in the Big Lost River were related to natural phenomenon and man-created impacts. Low winter flows resulted in a reduction in habitat and increased rainbow trout mortality. Man-altered flows stimulated movement and created deleterious conditions. Migratory patterns were related to water discharge and temperature. A food habit study of three sympatric salmonid fishes was undertaken during a low water period. The ratio of food items differed between the three species. Flesh of salmonid fishes from within the INEL Site boundary was monitored for three years for radionuclides. Only one trout contained Cs-137 concentrations above the minimum detection limits.

55546 (IDO—12087, pp 328-334) **Age, growth, and fecundity of the shorthead sculpin, Cottus confusus, in the Big Lost River, Idaho.** Gasser, K.W.; Cannamela, D.A.; Johnson, D.W. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Age, growth, and fecundity were examined for 513 shorthead sculpin collected from the Big Lost River, Idaho. Age determination by otoliths revealed six year classes with growth being fastest the first year (33 mm) and slowing to approximately 10 to 12 mm per year thereafter. Condition fluctuated seasonally and with habitat. Fecundity ranged from 184 to 511 eggs and is represented by a linear regresssion with standard length and number of eggs.

55547 (IDO—12087, pp 335-348) **Food habits of the shorthead sculpin, Cottus confusus, in the Big Lost River, Idaho.** Cannamela, D.A.; Gasser, K.W.; Johnson, D.W. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The diet of the shorthead sculpin was analyzed with respect to fish size in both autumn and spring and with respect to habitat in the spring sample. Indices of relative importance of food items and stomach fullness were developed for both samples. C. confusus showed seasonal variation in diet and feeding intensity. Trichoptera, Diptera, and Ephemeroptera larvae were the most important food items in the sculpin diet. Paragyractis sp. larvae (Lepidoptera) was an important food item in the spring. Fish, C. confusus, and fish eggs (also C. confusus) were utilized to some extent by the largest sculpin.

55548 (IDO—12087, pp 349-353) **Proposed studies of the Big Lost River on the INEL Site.** Fuller, R.K.; Griffith, J.S. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Drought conditions of 1977 led to a cessation in flow of the Big Lost River to the Idaho National Engineering Laboratory Site. Reestablishment of fish and aquatic invertebrates from a watered upstream section will be observed. When a fish population returns to the channel on the Site, a study of the physical parameters required to induce rainbow trout (Salmo gairdneri) movement and the behavioral responses which actually determine individual movement will be conducted.

55549 (IDO—12087, pp 354-356) **Instream flow determination in the Big Lost River, Idaho.** Cannamela, D.A.; Johnson, D.W. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory site. 1978 progress report.

The aquatic resources of the Big Lost River, Idaho, have been severely impacted by extreme flow reductions; irrigation demands override instream uses of the limited water supply. Winter low flows result from flood prevention measures on the Idaho National Engineering Laboratory (INEL) Site. These studies of the Big Lost River fishery on the INEL Site are directed at recommending adequate and obtainable stream resources maintenance flows. Computer simulation of the hydraulic and discharge parameters of the river, and fish population sampling will aid in determining adequate flows and will provide information and predictive models for fisheries management of similarly impacted areas in the Western United States.

55550 (IS-T—870) **Some structures of marine natural products.** Finer-Moore, J.S. (Texas Univ., Houston (USA). Health Science Center). Jul 1979. Contract W-7405-ENG-82. 198p. Dep. NTIS, PC A09/MF A01.

Thesis.

Applications of x-ray crystallographic methods to marine chemistry are discussed. Results of research on a biosynthetic problem: diterpenes from Dictyotaceae are discussed under the following section headings: history of the problem; dictyoxepin; dictyodial; and dictyolactone. Studies on marine ecology are reported under the following headings: symbiosis and antibiosis; metabolites from opisthobranch molluscs, including, dolabelladiene, 9-isocyanopupukeanane and 2-isocyanopupukeanane, and crispatone; metabolites of goronians and soft corals, including zooxanthellae and the metabolism of coelenterates, ophirin, sinularene, and erectene. (JGB)

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 55034

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 55039

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 55039, 55637

55551 (ANL/EES-TM—55) **Environmental evaluation of the PIES Trendlong Mid-Mid Scenario: Federal Region V.** (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 142p. Dep. NTIS, PC A07/MF A01.

This Regional Issues Identification and Assessment (RIIA), is an evaluation of the regional environmental impacts of future energy development. The impacts described for 1985 and 1990 are based on a national energy projection (scenario) that assumes medium energy demand and fuel supply through 1990 but does not incorporate the policies of the 1978 National Energy Act (NEA). The environmental impacts discussed in this volume are for Federal Region V. There are nine companion volumes, one for each of the other federal regions in the nation. The findings of this impact evaluation of the PIES TRENDLONG MID-MID Scenario for Federal Region V (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) are reported. In those areas of eastern Michigan and southeastern and central Wisconsin that have not attained National Ambient Air Quality Standards (NAAQS), there will be limited opportunities for mitigation of impacts from utility coal growth through emission offsets or improved control efficiencies. In Ohio, 30% of utility coal growth could be restricted primarily because of NAAQS nonattainment. Illinois, Indiana, and Ohio may also experience problems with oil-fired utilities in nonattainment areas, but fuel purchasinhg practices could reduce the air quality impacts. Utility and industrial siting along Lake Erie may require extensive pretreatment of effluents discharged into the Lake. Allocation of water from Lake Michigan for new facilities may become an issue in Wisconsin and Illinois where large water-for-energy demands conflict with other water uses. Surface mining activities in Illinois, Indiana, and Ohio are projected to disturb approximately 200,000 acres in the period 1975 to 1990, causing temporary or permanent shifts in productivity and land use. Much of the land in the mining area is presently in forest and crops. Deaths and illnesses resulting from employment in deep mining in Region V may increase 30 to 40% over 1975 levels.

55552 (ANL/EES-TM—56) **Environmental evaluation of the PIES Trendlong Mid-Mid Scenario: Federal Region VII.** (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 92p. Dep. NTIS, PC A05/MF A01.

Findings of the environmental impact evaluation of the PIES TRENDLONG MID-MID Scenario for Federal Region VII (Iowa, Kansas, Nebraska, and Missouri) are reported. Projected coal-fired utility expansion could be constrained in several areas because of projected TSP and SO_2 National Ambient Air Quality Standards (NAAQS) violations. Problems will be most pronounced in Iowa and Kansas, but could be incurred in any state in the region. Large coal and nuclear facilities projected for parts of Region VII may experience water availability problems. The Smokey Hill River in Kansas, the Skunk River in Iowa, and the Platte River in Nebraska may have limited water supplies for operating the projected increases in fossil fuel and nuclear generating facilities. Coal surface mining in Missouri (21,000 acres may be disturbed from 1975 to 1990) may create land-use conflicts. Region VII may not have the facilities or legal framework for mitigating the negative socioeconomic impacts that are projected to occur from the proposed energy development. Therefore, the potential for severe and pervasive socioeconomic impacts is great.

55553 **Analytical and biological analyses of test materials from the synthetic fuel technologies. I. Mutagenicity of crude oils determined by the Salmonella typhimurium/microsomal activation system.** Epler, J.L.; Young, J.A.; Hardigree, A.A.; Rao, T.K.; Guerin, M.R.; Rubin, I.B.; Ho, C.H.; Clark, B.R. (Oak Ridge National Lab., TN). *Mutat. Res.;* **57**: 265-276(1978).

The mutagenicity of crude industrial products and effluents was assayed with the Salmonella/microsomal activation system. Test materials (crude products from coal-conversion processes and natural crude oils) were initially fractionated into primary classes by liquid-liquid extraction and then further fractionated by column chromatography. Prescreening was accomplished over a wide concentration range with the Ames tester strains. Active fractions (mainly the neutral fractions containing polycyclic aromatic hydrocarbons and certain basic fractions) can be identified, and dose-response relationships can be established. Standard values are expressed as revertants/mg of the test material assayed with frameshift strain TA98 including metabolic activation with rat-liver preparations. Total mutagenic activity of synthetic fuel samples was consistently higher than that of natural crude controls. Activities of subfractions are roughly additive and presumably reflect the mutagenic potential of the whole test material. These results are being extended to other genetic assays. Chemical identification is carried out along with the bioassays.

BIOMEDICAL SCIENCES, BASIC STUDIES

55554 **Thermodynamic model of binding of flexible bivalent haptens to antibody.** Dembo, M.; Goldstein, B. (Los Alamos Scientific Lab., NM). *Immunochemistry;* **15**: 307-313(1978).

Studies by Wilder et al. of the binding of Fab' fragments to small haptens have shown that the cross-linking constant (the equilibrium constant for binding an additional Fab' fragment to a hapten-Fab' complex) is strongly dependent on the length of the hapten. We present a simple model for predicting the relationship between the intermolecular cross-linking constant and the monovalent hapten-antibody binding constant. In particular we used the model to obtain the dependence of the cross-linking constant on the length of th hapten, the depth to which the hapten fills th Fab' binding site, and the size of the Fab' fragment. To test the model, we devised expressions which allowed us to analyze the data of Wilder et al. From their data we determined the values of two parameters which we took to be unknown in the theory, the size of the Fab' fragment and the depth to which the hapten fills the Fab' binding site. The values arrived at in this way agreed well with published measurements of these parameters.

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 55515, 55517, 55518, 55519, 55522, 55524, 55526, 55527, 55528, 55529, 55530, 55531, 55532, 55545, 55547, 55548, 55600, 55609

55555 (CONF-790737—3) **Review of factors involved in bird-tower kills, and mitigative procedures.** Jaroslow, B.N. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From Mitigation symposium; Ft Collins, CO, USA (17 Jul 1979).

Between 5 million and 80 million birds are killed annually from collisions with man-made structures, with the largest kills occurring to passerine species on overcast nights during fall migration. An understanding of avian physiological and behavioral factors conducive to collision helps in development of methods for mitigation. Mitigating factors involve structure siting, light-source type ad frequency of the signal, and precautionary measures for overcast weather and bird migration seasons.

55556 (LA—7946-MS) **Mental dynamics.** Harlow, F.H. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 22p. Dep. NTIS, PC A02/MF A01.

The non-physical life activity within an organism is described mathematically by means of a basic formulation to which numerous variations and embellishments can be appended as required. The fundamental principle of overall activity normalization is presented and discussed in terms of its practical and philosophical consequences. Discrimin is introduced as a necessary complement to intelligence and creativity in the structure of genius. Future directions for development are described in terms of both deterministic and stochastic analysis for the organism as an isolated unit, as a member of society, and as an interacting element of the natural universe.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 55570, 55590, 55601, 55619, 55627

55557 (COO—2401-70) **Cellular proliferation and regeneration following tissue damage. Progress report.** Harding, C.V. (Wayne State Univ., Detroit, MI (USA). Kresge Eye Inst.). 1978. Contract EY-76-S-02-2401. 6p. Dep. NTIS, PC A02/MF A01.

Tissue cultures of rabbit retinal vasculature were studied in vivo and in vitro by scanning electron microscopy to elucidate the regnerative process from an injury. Human lens are now being compared with a goal for developing a bioassay for testing the effects of potentially toxic agents. (PCS)

55558 (COO—3162-49) **(Appendix to COO—3162-48) comprehensive three year report, September 1, 1975-November 30, 1978 including annual progress report, December 1, 1977-November 30, 1978.** Clayton, R.K. (Cornell Univ., Ithaca, NY (USA)). 10 Aug 1978. Contract EY-76-S-02-3162. 26p. Dep. NTIS, PC A03/MF A01.

Progress in biochemical reaction kinetics of photosynthetic energy conversion is reported. (PCS)

55559 **Net accumulation of adenine nucleotide by corn mitochondria.** Abou-Khalil, S.; Hanson, J.B. (Univ. of Illinois, Urbana). pp 141-149 of Plant mitochondria. Ducet, G.; Lance, C. (eds.). New York, NY; Elsevier/North-Holland Biomedical Press (1978).

Corn (Zea mays L.) shoot mitochondria have an energy linked mechanism for net accumulation of ADP or ATP. Phosphate and magnesium are required, and ADP accumulation is much increased if energy expenditure in ATP formation is prevented by oligomycin or carboxyatractyloside. Phosphate and magnesium are accumulated along with ADP, and in the presence of carboxyatractyloside the accumulated ADP is converted to ATP, demonstrating accessibility to the coupling ATPase. Kinetic analysis of ADP uptake in the presence of oligomycin shows the presence of low and high affinity transport systems; massive ADP accumulation is by the low affinity system (K/sub m//sup ADP/ = 3.8 mM). ADP accumulation is strongly inhibited by mersalyl and low temperature, partly inhibited by 8 mM citrate, and weakly or not at all by 8 mM 1,2,3-benzene tricarboxylate and succinate. Accumulated ADP will exchange rapidly with AMP, ADP, and ATP, but not other nucleotides or dicarboxylate anions. AMP is not accumulated and it probably enters into exchange after conversion to ADP; this may also apply to the transport of ATP which is half as efficient as ADP transport. It is suggested that there is a distinct transport system for net accumulation of ADP, and possibly citrate.

55560 (ORO—4182-9) **Differential gene expression in Neurospora crassa cell types. Comprehensive progress report, 1976-1979.** Dutta, S.K. (Howard Univ., Washington, DC (USA). Dept. of Botany). 1979. Contract EY-76-S-05-4182. 11p. Dep. NTIS, PC A02/MF A01.

Major research accomplishments are: isolation and characterization of rRNA and whole RNA genes from developmental cell types of Neurospora; differential transcription of non-repeated DNAs; sexual morphogenesis in DNA systems; characterization of RNase sensitive and RNA-bound RNA dependent DNA polymerase in N. crassa; differential RNase sensitive DNA polymerase in N. crassa mutants and other filamentous fungi; differential rRNA gene amplification in N. crassa development; groundwork for making N. crassa clones; and mathematical models for prediction of cell growths under environmental stress. The next three years' research objectives are given.

55561 (SAN—0899-T1) **Observation on immunohemopoletic marrow. Annual report, October 15, 1978-October 14, 1979.** Tavassoli, M.; Crosby, W.H. (Scripps Clinic and Research Foundation, La Jolla, CA (USA)). 1979. Contract EY-76-S-03-0899. 7p. Dep. NTIS, PC A02/MF A01.

Progress is reported on: Studies on marrow-blood barrier; Cellular relationship in hemopoiesis; Functional potential of marrow implant; Developmental potential of cultured fibroblasts; Fusion-fission reorganization of membrane, a developing membrane model to platelet formation from megakaryocyte; A_9C-induced membrane fusion, heterogeneity of membranes and transfer of fusibility; A safe substitute for benzidine; Cytochemical diagnosis of myelomonocytic leukemias; Studies on acid phosphatase in breast cancer; and erythroid cell cultures. Nineteen related publications are listed.

55562 (UR—3490-1586) **Isolation and characterization of a Ca^{2+} carrier candidate from calf heart inner mitochondrial membrane.** Jeng, A.Y. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-S-02-3490. 194p. Dep. NTIS, PC A09/MF A01.

Thesis.

A protein was isolated from calf heart inner mitochondrial membrane with the aid of an electron paramagnetic resonance assay based on the relative binding properties of Ca^{2+}, Mn^{2+}, and Mg^{2+} to the protein. Partial delipidation of the protein was performed by using either the organic solvent extraction procedure or the silicic acid column chromatography. Control experiments indicated that the Ca^{2+} transport properties of the isolated protein were not due to the contaminating phospholipids. A complete delipidation procedure was developd by using Sephadex LH-20 column chromatography. Further characterization of the physical and chemical properties of the delipidated protein showed that delipidated protein becomes more hydrophobic in the presence of Ca^{2+} and alkaline pH in the organic solvent extraction experiments. Two possible models of calciphorin-mediated Ca^{2+} transport in mitochondria are proposed. (PCS)

55563 **Metabolism of low molecular weight ribonucleic acids in early sea urchin embryos.** Nijhawan, P.; Marzluff, W.F. (Florida State Univ., Tallahassee). *Biochemistry;* **18**: No. 7, 1353-1360(3 Apr 1979).

There are three major low molecular weight RNAs (150 to 300 nucleotides) larger than 5S rRNA present in sea urchin embryos. Two of these are localized in the nucleus and one is localized in the cytoplasm. The nuclear species contain capped 5' termini, with a cap I structure. These RNAs are synthesized starting in late cleavage and continuing through pluteus. Relative to 5S RNA there is a 10-fold change in the rate of synthesis of these RNAs, due primarily to a decrease in their rate of transcription after blastula. The RNAs are metabolically stable and the nuclear RNA genes ae reiterated 50 to 100 times in the genome. Significant amounts of these RNAs are present in sea urchin eggs, enough to supply the embryo during early cleavage, prior to initiation of their synthesis.

55564 **Alterations in Bacillus subtilis transforming DNA induced by β-propiolactone and 1,3-propane sultone, two mutagenic and carcinogenic alkylating agents.** Kubinski, Z.O.; Kubinski, H. (Univ. of Wisconsin, Madison). *J. Bacteriol.;* **136**: No. 3, 854-866(Dec 1978).

Transforming DNA was exposed to either β-propiolactone or 1,3-propane sultone and then used for transformation of competent bacteria to nutritional independence from tyrosine and tryptophan (linked markers) and leucine (an unlinked marker). The ability to transform was progressively lost by the DNA during incubation with either of these two chemicals. The decrease in the transforming activity was in part due to the slower rate of penetration of alkylated DNA through the cellular membrane and its inability to enter the recipient bacteria. Presence of albumin during the incubation with a carcinogen further increased the degree of inactivation, indicating that the artificial nucleoproteins produced under such conditions were less efficient in the transformation assay than was the naked DNA. Cotransformation of close markers progressively decreased, beginning immediately after the start of incubation of DNA with the chemicals. Extensively alkylated DNA fractionated by sedimentation through sucrose density gradients showed a peculiar distribution

of cotransforming activity for such markers; namely, molecules larger than the bulk of DNA (megamolecules) showed less ability to transform the second marker than did some of the apparently smaller molecules which sedimented more slowly through the gradient. An increase in cotransformation of distant markers was evident in DNA molecules after a short exposure to an alkylating agent, but cotransformation of such markers was absent in DNA treated for longer periods. The observed changes in the transforming and cotransforming activities of the alkylated DNA can be explained by what is known about the physicochemistry of such DNA and in particular about the propensity of the alkylated and broken molecules to form complexes with themselves and with other macromolecules.

TRACER TECHNIQUES

55565 (BNL—25983) **Design of irreversible inhibitors.** Shaw, E.N. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 36p. Dep. NTIS, PC A03/MF A01.

Feasbility studies are reviewed for using enzyme inhibitors for drug design. Mechanisms by which enzymes act have been studied and those results are reviewed with the variable approaches discussed. (PCS)

55566 **Characterization of fatty alcohol:NAD$^+$ oxidoreductase from rat liver.** Lee, T. (Oak Ridge Associated Univ., TN). Contract EY-76-C-05-0033. *J. Biol. Chem.;* **254**: No. 8, 2892-2896(25 Apr 1979).

Long chain fatty alcohols are known to be rapidly oxidized to the corresponding fatty acids in normal mammalian tissues in vivo. However, the enzyme system responsible for the reaction has not been well documented. We have demonstrated the conversion of [1-^{14}C]hexadecanol to [1-^{14}C]hexadecanoic acid using a cell-free system from rat liver. The subcellular distribution of this enzyme system parallels that of microsomal marker enzymes. The enzyme showed an absolute requirement for NAD$^+$ and had a pH optimum of 8.4. Neither NADP$^+$, NADH, nor NADPH can substitute for NAD$^+$ as a cofactor. The reaction does not require oxygen. Albumin increases the rate of the reaction. The enzymic activity is not affected by including pyrazole, sodium azide, or AMP, ATP, and quinacrine in the incubation mixture. The apparent K/sub m/ for hexadecanol is 0.67 μM and the V/sub max/ is 5.98 nmol/min/mg of protein. The reaction product was identified as the fatty acid by both thin-layer and gas-liquid chromatography. Fatty aldehyde was also isolated and identified from the reaction mixture. Addition of semicarbazide to the incubation system increased the amount of fatty aldehyde produced with concomitant decrease in the formation of fatty acid. This documents that aldehyde is an intermediate in the reaction. This oxidoreductase is found in most tissues but has the highest activity in liver.

CYTOLOGY

REFER ALSO TO CITATION(S) 55564, 55621, 55626

55567 (BNL—26544) **Megakaryocyte growth in in vitro cultures and in diffusion chambers.** Paulus, J.M.; Carsten, A.L.; Cronkite, E.P.; Lacaze, N. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-7906124—1). Dep. NTIS, PC A02/MF A01.

From Diffusion chamber culture workshop; Upton, NY, USA (25 Jun 1979).

Analysis of colony size distribution and ploidy in in vitro cultures of megakaryocytes suggests that variability in cell cycle times, diversity of precursors and possibly local changes in microenvironment all contribute to the heterogeneity of megakaryocyte colonies. Megakaryocytes can also be grown in diffusion chambers, although with a somewhat smaller plating efficiency and smaller colonies than in in vitro cultures.

55568 (BNL—26620) **Introduction for diffusion chamber culture symposium.** Carsten, A.L. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 19p. (CONF-790869—1). Dep. NTIS, PC A02/MF A01.

From 8. annual conference of the International Society for Experimental Hematology; Rotterdam, Netherlands (21 Aug 1979).

The diffusion-chamber system has been applied to studies of cell kinetics, progenitor cell quantitation, humoral effects, immunological effects, cytogenetics, organogenesis, and the cellular effects of drugs and physical factors such as radiation, hypoxia, etc. Chamber contents have been analyzed by clot dissolution with measuring of cell content, limiting dilution evaluation, radionuclide utilization (tritiated thymidine labeling), growth of colony number, size and type, CFU-S or CFU-C content, or proliferation by secondary culture in mice or in vitro systems, and chromosome changes. Cell types ranging from embryonal tissues to adult normal and neoplastic tissues have been grown in hosts across species barriers. Advantages and disadvantages of this system are discussed.

55569 **Data analysis of four x-chromosome inactivation experiments.** Kane, V.E. (Union Carbide Corp., Oak Ridge, TN). pp 465-477 of Genetic mosaics and chimeras in mammals. Russell, L.B. (ed.). New York, NY; Plenum Publishing Corp. (1978).

A statistical model of embryonic development is presented which formalizes estimation of the probability that a particular X chromosome is inactivated. It is possible to estimate the cell-pool size at the time of both X-chromosome inactivation and organ-precursor cell-pool selection. Some developmental hypotheses of interest are also tested statistically. A byproduct of the statistical model is a precise formulation of the biological and statistical assumptions implicitly used in the data analysis of some mosaic experiments. An analysis of four X-chromosome experiments is presented to illustrate the application of the statistical model.

55570 (ORO—3628-13) **Mechanisms of innate immunity. Cytoplasmic granules of polymorphonuclear neutrophilic granulocytes, antimicrobial action, translocation, role and fate in antimicrobial phagocytosis. Final progress report.** Spitznagel, J.K. (North Carolina Univ., Chapel Hill (USA). Dept. of Bacteriology and Immunology). 1979. Contract EY-76-S-05-3628. 8p. Dep. NTIS, PC A02/MF A01.

Research includes: distribution of proteinases and cationic proteins in human polymorphonuclear granulocytes (PMN); description of specific eosinophil granules of PMN with comparison with granules of human PMN; identification of a cyanide resistant NADPH oxidase in PMN and its cosedimentation characteristics; subcellular localization of superoxide dismutase in human PMN; oxygen dependent antimicrobial activities of each granule class; distribution and appearance of specific granule enzymes in circulating leukocytes and degranulation during phagocytosis; phagocytic and intraleukocytic killing capacity of PMN deprives of their specific granules with phorbol myristate acetate, a co-carcinogen; and the PMN of an infant with Chediak Higashi syndrome, the leukocytes from two young men with chronic granulomatous disease of childhood and the PMN of many leukemic patients. Eleven papers have resulted from these studies.

55571 **Ability of thymic lymphocytes to alter CFU kinetics in radiation chimeras.** Shinpock, S.G.; Goodman, J.W. (Oak Ridge National Lab., TN). *Cell Tissue Kinet.;* **11**: 111-117(1978).

It is known that the poor colony-forming ability of B6 bone marrow transplanted into B6D2F$_1$ hybrids can be improved if B6 lymphocytes are given in addition. It was recently reported that the augmenting lymphocytes decrease the doubling time of differentiating hemopoietic cells. To determine whether thymus cells alter the self-renewal of CFUs in this parent→ F$_1$ combination, retransplantation and ^{3}H-thymidine suicide were employed as methods to determine the cell-division rate. We have observed that in the presence of thymocytes, parental bone marrow cells are seeded more efficiently in the spleen, and the lag phase of the CFUs growth curve is shortened. However, thymic lymphocytes do not increase the slope of the exponential growth phase of CFUs.

55572 **Light-scattering system for high-speed cell analysis.** Crowell, J.M. (Univ. of California, Los Alamos, NM); Hiebert, R.D.; Salzman, G.C.; Price, B.J.; Cram, L.S.; Mullaney, P.F. *IEEE Trans. Bio-Med. Eng.;* **25**: No. 6, 519-526(Nov 1978).

A flow-system instrument is described in which the light scattered by a biological cell is detected simultaneously at 32 angles in the forward direction as the cell passes through a focused laser beam at 10 m/s. Cluster analysis is applied to the scatter pattern data to enable discrimination among cell types.

55573 **Somatic mutations and aging.** Hirsch, G.P. (Oak Ridge National Lab., TN). pp 91-134 of Genetics of aging. Schneider, E.L. (ed.). New York, NY; Plenum Publishing Corporation (1978).

New support for the somatic mutation hypothesis of aging has been obtained in recent years from the correlations that exist between the cancer-inducing nature of chemicals and their mutagenic effects. The mutagenic extrapolation to a primary mechanism of aging derives from the overwhelming occurrence of cancer among older persons. Validation of this hypothesis of mutational cancer etiology can be expected to result from test systems that measure somatic mutations in vivo, especially in the target tissue for a given carcinogenic protocol. One such system, utilizing the hemoglobin molecule as an end point, measures base-substitution mutations and errors. The rather accurate synthesis of proteins allows the estimation of somatic base substitutions among molecules derived from bulk tissue or populations of cells. Thus, age-associated changes that were thought to arise from an increase in the level of errors might demonstrate instead accumulated mutations. Measurement of the fidelity of cellular DNA replication among long- and short-lived species, i.e. species comparisons of spontaneous mutation rates, should provide some answers as to the relative selective pressures governing DNA polymerase fidelity. The significance of mutations in dividing cells to aging processes depends to a large degree on the

nature of cellular proliferation. Selective killing of progenitor cells to the hemopoietic stem cell suggests that somatic mutation accumulation by cell-division mechanisms may not be applicable in mammals. In contrast to the noncycling state of some stem cells and to the preponderance of nondividing cells in the adult mammal, the mitochondrial genome is especially susceptible to mutation accumulation through replication error mechanisms. Other theories which have been proposed are also discussed.

GENETICS

REFER ALSO TO CITATION(S) 55560, 55573, 55594, 55598, 55630

55574 (ANL/BIM—79-1) **Review of short-term screening tests for mutagens, toxigens, and carcinogens.** Carney, H.J.; Hass, B.S. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 67p. Dep. NTIS, PC A04/MF A01.

In order to test the thousands of man-made chemicals in the environment for carcinogenic and genetic hazards, a multitude of short-term screening tests has been developed to complement long-term mammalian bioassays and epidemiological studies. These tests cover a broad spectrum of organisms, and include the use of naked and viral nucleic acids, bacteria, fungi, higher plants, insects in vitro mammalian cell cultures (cell transformation, cell-mediated mutagenesis, DNA repair, and chromosome aberration tests) and live mammals. Assay end points include effects on nucleic acids, DNA repair synthesis, point or gene mutation, structural and numerical chromosome aberrations, cytological alterations, and in vitro cell transformation. The present review describes and compares these assays. In addition, it discusses their historical development, the problems and limitations associated with their use, and their implementation in comprehensive testing programs. It is intended to provide overview and specific information to the laboratory that is in the process of establishing genetic toxicological systems. (The literature is reviewed to January 1978.)

55575 (CONF-7905114—1) **Comparative vs ontogenetic paradigms for tests of the intrinsic mutagenesis hypothesis of aging.** Sacher, G.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From Structural pathology in DNA and the biology of aging; Freiburg, F.R. Germany (13 May 1979).

This paper examines certain aspects of the biology of longevity and aging that bear on the role of DNA in the ontogenetic aging process, and on the genetic basis for the differences of longevity among mammal species. (PCS)

METABOLISM

REFER ALSO TO CITATION(S) 55538, 55547, 55550

55576 (ORO—5465-1) **Benthic community metabolism on the continental shelf of the northern Gulf of Mexico.** Pamatmat, M.M. (Auburn Univ., AL (USA). Dept. of Fisheries and Allied Aquacultures). 3 Apr 1979. Contract EE-77-S-05-5465. 8p. Dep. NTIS, PC A02/MF A01.

Rates of oxygen uptake on the continental shelf indicate large temporal changes and significant differences between stations. Similar measurements at 10, 50, and 100 m distance from an operating oil rig revealed rates of benthic community metabolism that have no apparent effect from the oil rig presence and operation. Anaerobic experiments on pure cultures of Clostridium sporogenes and Bacteroides sp. and on a mixed culture of mostly Bacteroides with an unidentified coccus, showed highly significant correlations between various measures of metabolic activity and standing stock. The excellent correlations between ATP, turbidity, total dehydrogenase activity, and rate of heat production hold through the stationary phase of growth; thereafter the correlation breaks down. Highly significant but variable regressions of heat production rate on ATP concentration in sediments, indicate that ATP concentration of sediments may be a fairly good estimate of living microbial biomass but the same concentration of ATP in different locations at various times could represent different levels of metabolic activity. Anaerobic metabolism of bivalves and a polychaete is a linear function of body size. There is no significant difference between species. The pooled average weight-specific heat production rate is 1.77×10^{-4} W g^{-1} of dry tissue. Anaerobic metabolism is about 5% of aerobic metabolism in two bivalve species and indicates an energy saving during anaerobiosis.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 55625

MEDICINE

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 55342, 55591, 55613

55577 (COO—2541-2) **Applications of CdTe to nuclear medicine. Annual report, February 1, 1978-January 31, 1979.** Entine, G. (Radiation Monitoring Devices, Inc., Watertown, MA (USA)). 1979. Contract EY-76-C-02-2541. 5p. Dep. NTIS, PC A02/MF A01.

The use of CdTe radiation detectors in medical applications continues to become more widespread. During this contract period a CdTe detector as small as 1 mm^3 was inserted into a bronchoscope while a CdTe array as large as 4200 mm^3 was used as a prototype gamma camera. Portable battery powered instrumentation was also developed to further enhance the versatility of the CdTe concept. One of these electronic packages which is used in several hospitals is illustrated. The unit provides an LED digital readout and timing circuits to vary the measuring time between 1 and 500 seconds. The total weight is below 0.6 g. The units have been used with several specialized CdTe probes including a plutonium wound probe, a nuclear dentistry probe, an implantible heart probe and an I-125 Fibrinigen sensor. These special probes are also illustrated.

55578 (ORNL/TM—6916) **Health and safety research division. Nuclear medicine technology progress report for period ending March 31, 1979.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

The preparation of a unique class of trimethyltin-substituted steroids is described that were designed because of the potential use of the /sup 117m/Sn-labeled analogs for adrenal imaging. The trimethyltin-substituted steroids were readily prepared on the microscale in yields ranging from 40 to 80%. Studies with the /sup 123m/Te-labeled fatty acids have continued, and radiolabeled 6-telluraheptadecanoic acid and 11-telluraheptadecanoic acid have shown pronounced heart uptake in rats. These results suggest that the position of the tellurium heteroatom has little effect on the heart uptake of the telluraheptadecanoic acids. Interest in the potential use of ^{75}Se-labeled agents for tomographic imaging applications has resulted in the preparation of several ^{75}Se-labeled compounds for preliminary tissue distribution studies in rats. Significant heart uptake was observed with ^{75}Se-labeled-9-selenoheptadecanoic acid, suggesting that the various structural features affecting heart uptake of seleno fatty acids should also be explored. In addition, ^{75}Se-labeled 24-(isopropyl seleno)-chol-5-en-3β-ol was prepared and showed pronounced adrenal uptake in rats. The results of continuing studies with ^{11}C-labeled amino acids in a collaborative project with the Oak Ridge Associated Universities (ORAU) are also described. Recent patient studies at ORAU have established that ^{11}C-DL-tryptophan is superior to ^{11}-DL-valine for pancreatic visualization by positron emission tomography. Nitrogen-13 was prepared for the first time in the ORNL 86-inch cyclotron and converted to ^{13}N-ammonia that was used successfully to visualize dog hearts. (ERB)

55579 (ORNL/TM—6958) **Nuclear medicine technology progress report for quarter ending June 30, 1979.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

Diffusion chamber assay system studies on the relative cytotoxicity and target cell uptake of /sup 195m/Pt-labeled cis- and trans-dichlorodiammineplatinum(II) (cis- and trans-DDP) are reported. These two agents are excellent candidates for such studies since cis-DDP is an established potent antitumor agent while the trans-isomer exhibits little antitumor activity. The KB tumor cell population in chambers from the cis-DDP-treated animals decreased while the cell population in chambers from the trans-DDP-treated animals increased. Cytotoxicity data obtained in the study are similar to results from in vivo studies. The results of continuing studies with / sup 117m/Sn, /sup 123m/Te, ^{75}Se, ^{11}C, and /sup 195m/Pt-labeled agents are also described. A series of five /sup 117m/Sn-labeled steroids containing a variety of structural modifications have been prepared. Future tissue distribution studies in rats will determine the potential usefulness of these agents for adrenal imaging applications. Based upon our studies with ^{75}Se-labeled steroids (adrenal imaging) and fatty acids (myocardial imaging), the potential use of the ^{75}Se-labeled agents for emission computerized axial tomographic applications is also discussed. Calculations of the estimated radiation dose to humans from two /sup 123m/Te-labeled steroids which suggest the potential clinical usefulness of these agents for adrenal visualization have been completed. Patient studies have continued with ^{11}C-aminocyclobutanecarboxylic acid (ACBC) and ^{11}C-tryptophan. Continuing studies with /sup 195m/Pt-labeled antitumor agents are also reported. (ERB)

55580 **Effect of desferoxamine on tissue and tumor retention of gallium-67: concise communication.** Hoffer, P.B.; Samuel, A.; Bush-

berg, J.T.; Thakur, M. (Yale Univ., New Haven, CT). *J. Nucl. Med.;* **20**: No. 3, 248-251(Mar 1979).

Desferoxamine (DEF) was administered intramuscularly (0.25 mg/g body weight) to mice harboring a Cloudman's melanoma S-91 3 h before, simultaneously with, and 3 h after iv injection of Ga-67 citrate (approximately 1 μCi/g body weight). Relative Ga-67 retention was compared with that in non-DEF controls at 24 h. The chemical nature of Ga-67 excreted in urine following DEF was also studied in healthy mice. Desferoxamine administered 3 h before Ga-67 had little effect on radiogallium localization; administration coincident with or 3 h after radiogallium resulted in decreased retention at 24 h. The effect was profound when Ga-67 and DEF were administered simultaneously. In DEF-injected animals Ga-67 was excreted in the urine as a Ga-67 DEF complex. When DEF was administered 3 h after Ga-67, there was a trend to greater tumor-to-blood activity ratios ($0.2 > p > 0.1$).

55581 Relationship of computed tomography, gray-scale ultrasonography and radionuclide imaging in the evaluation of hepatic masses. Petasnick, J.P.; Ram, P.; Turner, D.A.; Fordham, E.W. (Rush-Presbyterian-St. Luke's Medical Center, Chicago, IL). *Semin. Nucl. Med.;* **9**: No. 1, 8-21(Jan 1979).

Hepatic scintigraphy, gray-scale utrasonography, and computed tomography have proven to be useful in the initial detection and evaluation of hepatic masses. These studies appear to be complimentary since each provides information not available from the others. Hepatic scintigraphy is currently the method of choice for the initial evaluation of the liver for mass lesions as it is easily performed, relatively inexpensive, and affords detectability of intrahepatic mass lesions at least as great as that of ultrasonography or computed tomography. When a definite or suspected abnormality is seen by hepatic scintigraphy, computed tomography or ultrasonography may be helpful in providing better anatomic definition or clarification of the nature of the abnormality. The choice between these latter two modalities depends on the type of scanning equipment available and the observer's experience with each method.

55582 Cholescintigraphy, ultrasonography and computerized tomography in the evaluation of biliary tract disorders. Weissmann, H.S.; Frank, M.; Rosenblatt, R.; Goldman, M.; Freeman, L.M. (Montefiore Hospital and Medical Center, Bronx, NY). *Semin. Nucl. Med.;* **9**: No. 1, 22-35(Jan 1979).

Newer modalities available for the evaluation of hepatobiliary disease include cholescintigraphy, ultrasonography, and computerized tomography. We have examined the relative strengths and weaknesses of each of these noninvasive techniques and developed a rational diagnostic approach for the evaluation of acute cholecystitis, chronic cholecystitis, and cholestasis. The procedure of choice for suspected acute cholecystitis is /sup 99m/Tc-HIDA cholescintigraphy because it is a highly accurate method for obtaining functional information with regard to cystic duct patency. In suspected chronic cholecystitis, the oral cholecystogram is the best screening procedure, followed by ultrasound for confirmation of gallbladder disease as the cause of nonvisualizaion. The role of /sup 99m/Tc-HIDA cholescintigraphy in suspected chronic cholecystitis is limited to those cases where the oral cholecystogram and sonogram yield disparate results, or where a patient is known to have chronic gallbladder disease and super-imposed acute exacerbation is suspected. Ultrasonography is recommended as the initial procedure for evaluation of the patient with cholestasis. It is highly accurate in distinguishing hepatocellular disease from obstructive jaundice, and when dilated biliary radicles are visualized, ultrasonography is frequently capable of identifying the cause of obstruction. If the patient's body habitus or gaseous distention makes ultrasonographic evaluation difficult, then computerized tomography is recommended, followed by endoscopic retrograde cholangiopancreatography or transhepatic cholangiography, when needed.

55583 Multiple imaging modalities for the study of pancreatic disease. Partain, C.L.; Staab, E.V.; McCartney, W.H. (Univ. of North Carolina, Chapel Hill). *Semin. Nucl. Med.;* **9**: No. 1, 36-42(Jan 1979).

Gray scale ultrasonography (US) and computed tomography (CT) have enhanced the role of various imaging modalities in the evaluation of patients with suspected pancreatic disease. When these anatomical studies are normal or equivocal, a functional, radionuclide pancreas scan may be useful. Pancreatic imaging can be achieved using ultrasound, transmission CT, single photon radionuclide imaging, and positron emission CT. A diagnostic imaging decision chart for the evaluation of patients with possible pancreatic disease is useful in choosing the correct imaging modality in a specific situation. Such a chart and its theoretic basis are described in this review. The need to optimize the pancreatic work-up with respect to cost-benefit decisions and diagnostic accuracy, sensitivity, and specificity are of particular concern to the physician. Of all the potential areas for disease, the pancreas has been and remains a particularity difficult diagnostic problem.

55584 Renal imaging with radionuclides, ultrasound, and computed tomography. Kahn, P.C. (Tufts Univ. School of Medicine, Boston, MA). *Semin. Nucl. Med.;* **9**: No. 1, 43-57(Jan 1979).

Nuclear medicine, ultrasound, and computed tomography have all contributed greatly to the diagnosis and understanding of renal disease. The /sup 99m/Tc-glucoheptonate scan is a multipurpose test for evaluating blood flow, cortical function and excretion, and the location of renal tissue. It is especially useful in renal trauma and vascular disease, congenital anomalies, and pseudomasses. Technetium-99m diethylene triamine pentaacetic acid (DTPA) is most helpful in evaluating obstruction and reflux, and ^{67}Ga citrate has a major role in inflammatory disease. The gray-scale ultrasound examination helps to characterize masses as cysts, abscesses, or tumors, and is particularly helpful in localization for aspiration, biopsy, or drainage procedures. Its total innocuousness makes echography useful for sequential follow-up in hydronephrosis and masses. Computed tomography with a fast scanner allows the identification of small lesions, and gives the most anatomic information. It permits the differentiation of fat from pelvic tumors and small cysts from neoplasms, and clearly identifies perirenal structures. With contrast enhancement, additional information about the vascularity of lesions is obtained. Although these tests use different physical principles and instruments, the data they provide are often similar, and for practical purposes the use of one modality may preclude the use of others. Difficult judgments are required to make certain that the proper examination or sequence of examinations is done in each case.

55585 Roles of Gallium-67 scintigraphy, ultrasonography, and computed tomography in the detection of abdominal abscesses. Biello, D.R.; Levitt, R.G.; Melson, G.L. (Mallinckrodt Inst. of Radiology, St. Louis, MO). *Semin. Nucl. Med.;* **9**: No. 1, 58-65(Jan 1979).

The evaluation of patients with suspected abdominal abscesses begins with a history and careful physical examination. Gallium-67 (^{67}Ga) scintigraphy, ultrasonography (US), and computed tomography (CT) are utilized only after other routine investigations have failed to localize the abscess. All three modalities are reliable for the detection of abdominal abscesses. The decision regarding which of these three diagnostic tests to use in a particular patient rests upon clinical considerations. If the patient has acute localizing signs and symptoms, ^{67}Ga should not be used initially. In this type of patient, rapid diagnosis is best provided by either US or CT. Further radiologic investigation may be terminated if the CT or US findings are characteristic of an abscess. A ^{67}Ga scan should be performed in a patient with acute localizing signs and symptoms if the initial CT or US is negative. In a patient with nonlocalizing signs and symptoms, ^{67}Ga imaging should be employed as the first procedure since the entire body is easily surveyed. If the ^{67}Ga images are abnormal, then CT or US should be utilized for further lesion characterization. This diagostic approach will optimize the rapidity of patient evaluation and will minimize diagnostic errors.

55586 Anatomic correlations in radiogallium imaging of the peritoneum and retroperitoneum. Myerson, P.J.; Myerson, D.A.; Spencer, R.P. (Univ. of Connecticut Health Center, Farmington). *Semin. Nucl. Med.;* **9**: No. 1, 66-70(Jan 1979).

Radiogallium (^{67}Ga) imaging of the abdomen and pelvis has been useful not only in detecting inflammations in these regions, but in pointing out their precise anatomic localization. Once the anatomic site is determined, it is often possible to infer the source of origin of the problem (such as ruptured viscus or pancreatitis). Interpretation of the images depends on recognition of patterns that define known anatomic boundaries such as the transverse mesocolon, root of the small mesentery, perirenal space, and pararenal space, or else show diffuse peritoneal uptake. The anatomic patterns may have continued usefulness in future studies, such as when radiolabeled leukocytes are employed to localize inflammations.

55587 Heavy-ion radiography: density resolution and specimen radiography. Sommer, F.G. (Univ. of California School of Medicine, San Francisco); Capp, M.P.; Tobias, C.A.; Benton, E.V.; Woodruff, K.H.; Henke, R.P.; Holly, W.; Genant, H.K. Contract Y01-CB-40342. *Invest. Radiol.;* **13**: No. 2, 163-170(Mar 1978).

Heavy-ion radiography is performed by the passage of a beam of nuclei accelerated to energies of several hundred MeV/nucleon through an object. The technique of recording transmitted nuclei in a downstream stack of plastic sheets affords excellent resolution of density by recording the nuclei only at their stopping points. Imaging of a phantom - which simulated tumors of low density contrast in a body part - by conventional radiography, computed tomographic scanning and the heavy-ion technique indicated superior density resolution for heavy-ion imaging at low radiation dose. Superior imaging of tumors in pathologic specimens was demonstrated for heavy-ion imaging compared to conventional radiography. Values of stopping power for various tumors and normal tissues were determined by a computer-aided technique. Heavy-ion radiography shows promise for superior imaging of low contrast tumors at relatively low radiation dose levels.

EXTERNAL RADIATION IN DIAGNOSTICS

55588 (CONF-7811138—1) **Proton radiography application to medical imaging.** Kramer, S.L.; Moffett, D.R.; Martin, R.L.; Colton, E.P.; Steward, V.W. (Argonne National Lab., IL (USA); Chicago Univ., IL (USA)). 1978. Contract W-31-109-ENG-38. 40p. Dep. NTIS, PC A03/MF A01.

From 64. scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL, USA (25 Nov 1978).

In order to demonstrate the potential advantages of proton radiography for medical imaging, a 205 MeV proton radiography beam was developed using the Argonne National Laboratory Booster I synchrotron. Data were taken using a narrow scanning beam and an electronic detector system. The proton radiographs presented here demonstrate a significant dose reduction and improved mass resolution over conventional x-ray techniques. The radiographs also show significant differences in the proton stopping power of biological tissues and, therefore, considerable potential in soft tissue imaging. Also presented is the motivation for the interest in developing a proton tomographic scan system.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 55564, 55570, 55576, 55594, 55621, 55626

55589 (DOE/EV/03941—44) **Mechanisms of recombination and function of DNA in bacteria. Progress report, August 12, 1978-August 15, 1979.** Guild, W.R. (Duke Univ., Durham, NC (USA). Dept. of Biochemistry). 1979. Contract EY-76-S-05-3941. 5p. Dep. NTIS, PC A02/MF A01.

Most work in the current period centered on the organization and transfer of two classes of drug-resistance determinants in pneumonococcus: (a) insertions of foreign DNA in the chromosome; and (b) plasmid carried genes. Major findings are: determinants for chloramphenicol and tetracycline resistance in some clinical isolates of pneumococcus are present as adjacent insertions of heterologous DNA into the normal chromosome. They are not carried on plasmids as are similar determinants in many species; pneumonococcus will support the growth of resistance plasmids from other streptococci, and these can be transformed into pneumococcus from lysates of S. faecalis (group D) or group B streptococcus; one of the plasmids that has been transformed into pneumococcus mediates a form of DNAse-resistant conjugal transfer among other streptococcal groups and also in pneumococcus. (PCS)

MORPHOLOGY

REFER ALSO TO CITATION(S) 55572

PATHOLOGY

REFER ALSO TO CITATION(S) 55630, 55634

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 55628

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 55546, 55557, 55563, 55573

55590 **Adsorption of divalent cations to phosphatidylcholine bilayer membranes.** McLaughlin, A. (Brookhaven National Lab., Upton, NY); Grathwohl, C.; McLaughlin, S. *Biochim. Biophys. Acta;* **513**: 338-357(1978).

Electrophoretic mobility and ^{31}P nuclear magnetic resonance (NMR) measurements were combined to test whether the combination of the Henry, Boltzmann and Grahame equations is capable of describing the adsorption of divalent cations to phosphatidylcholine membranes. Cobalt was chosed for this study because, of all the common divalent cations, its effects on the ^{31}P NMR spectrum of phosphatidylcholine membranes are easiest to interpret. Both the ^{31}P NMR data on the adsorption of cobalt and the zeta potential data calculated from the electrophoretic mobility in the presence of cobalt are well described by the combination of these three equations. Electrophoretic mobility measurements were also performed with a number of other divalent cations and the zeta potentials were, in all cases, well described by the combination of these three equations. The binding deduced from such measurements decreases in the sequence: Mn^{2+}, Mg^{2+}, Ca^{2+}, Co^{2+}, Ni^{2+}, Sr^{2+}, Ba^{2+}. If we assume that a lipid molecule occupies an area of 60 A^2 and that there is a 1:1 stoichiometry for the binding of the divalent ions to phosphatidylcholine, the dissociation constants are, respectively: 0.3, 1.0, 1.0, 1.2, 1.2, 2.8, 3.6 M.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 55625, 55628

55591 **Mathematical foundations of compartmental analysis in biology, medicine, and ecology.** Sandberg, I.W. (Bell Labs., Murray Hill, NJ). pp 532-538 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

The basic equations of compartmental analysis are a system S of differential equations which govern the exchanges of material among various compartments and an environment. The equations are ordinarily nonlinear. In this paper we indicate that, if certain natural conditions are satisfied, S possesses an equilibrium point, and that if additional reasonable conditions are met the equilibrium point is unique and globally stable. These results have natural interpretations, and, in particular, provide an analytical basis for the use of the familiar linear tracer-analysis equations. We also consider the case in which S takes into account cyclic variations with a given period tau (this case often arises in ecological studies) and indicate that under certain reasonable conditions, S has a tau-periodic solution that is approached by every solution of S.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 54451, 55055, 55127, 55133, 55177, 55522, 55523, 55549

55592 (CONF-7805129—, pp 61-69) **Harvesting and drying high moisture wheat.** Barrett, J.R.; Parsons, S.D.; McKenzie, B.A. (Purdue Univ., West Lafayette, IN). 1978.

From Solar grain drying conference; West Lafayette, IN, USA (2 May 1978).

The following topics are discussed: managing high-moisture wheat harvest; methods of drying wheat; high speed batch and continuous flow drying processes; in-bin drying; managing bin-drying by harvest moisture contents; mold development, fan operation; influence of heat on mold growth; air flow, static pressure, and fan horsepower; flooring and duct systems; heat sources, solar, LP, etc.; economics of drying wheat for double-crop soybeans; and managing grain in storage. (MHR)

55593 (LA-UR—79-2018) **Balance sheets and US dairy farms.** Nott, S.B. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. (CONF-790718—2). Dep. NTIS, PC A02/MF A01.

From American Agricultural Economics Association meeting; Pullman, WA, USA (29 Jul 1979).

The first objective of this paper is to present balance sheet information pertaining to dairy farms as published in several different states and as an incidental benefit make you aware of the several sources from which this information is available. The second objective is to present some of the ways farm management specialists and agricultural economists are currently analyzing dairy farm balance sheets. No attempt is made to analyze or pass judgement on the data presented.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN MICROORGANISMS

55594 (DOE/EV/01071--1) **Genetics and biochemistry of DNA repair in Neurospora crassa. Progress report.** Mishra, N.C. (South Carolina Univ., Columbia (USA). Dept. of Biology). Apr 1979. Contract EP-78-S-09-1071. 5p. (CONF-791026—1). Dep. NTIS, PC A02/MF A01.

From Cell biology conference; Toronto, Canada (Oct 1979).

Mutants of Neurospora, presumably defective for deoxyribonuclease and DNA polymerase are being biochemically characterized and compared with the wild type enzyme to establish which enzymes control a particular function in DNA repair and other aspects of DNA biosynthesis. After biochemical characterization, these mu-

tants will be also examined for their ability to repair damage caused by exposure to radiation, radiomimetic drugs and carcinogens. Also, a number of Neurospora mutants which are known to be sensitive to uv radiation or to MMS (methyl methane sulfonate) or to histidine or defective in recombination are being characterized for DNA polymerases and nucleases to elucidate the biochemical basis of these defects. These studies will provide a detailed knowledge of the different aspects of DNA repair and the role of the key enzymes therein. The results of present studies involving a eukaryote can be meaningfully generalized for similar studies in humans. Efficient DNA repair in man is necessary for the maintenance of normal growth and for exposure to the sunlight and to various radiomimetic chemicals present in our environment. Due to the introduction of various chemicals in our environment, there is increased risk of damage to our own genetic material (including that of our crop and cattle) and the outcome of the proposed study may provide a meaningful insight into these problems.

IN ANIMALS

REFER ALSO TO CITATION(S) 55596

55595 (ORO—3329-13) **Regulatory mechanisms of eosinopoiesis. Final technical report.** Ottolenghi, A.; Bernheim, F. (Duke Univ., Durham, NC (USA). Dept. of Pharmacology). 1979. Contract EY-76-S-05-3329. 8p. Dep. NTIS, PC A02/MF A01.

Studies were performed with whole-body and partial-body x-irradiation of mice to examine regenerative response of major hematopoietic sites and peripheral pools. Doses from 150 to 600 r were given with various forms of shielding. From consistent results, the author concluded that the shielded marrow was responding to a specific eosinophilic stimulus possibly originating in the irradiated areas with a time course independent of the regenerative pattern of the other nucleated elements of the marrow. (PCS)

RADIATION EFFECTS ON CELLS

55596 (CONF-790676—6) **Repair and mutation induction in mouse germ cells: a summary and some thoughts.** Russell, L.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From Conference on DNA repair and mutagenesis in bacteria; Atlanta, GA, USA (25 Jun 1979).

The various lines of evidence for repair of premutational damage in mouse germ cells are reviewed with the implications for future experiment planning. Relation between mutagenicity and carcinogenicity are discussed. (PCS)

55597 (ORO—3631-9) **Radiation damage and repair in cells and cell components. Progress report, 1978-1979.** Fluke, D.J.; Pollard, E.C. (Duke Univ., Durham, NC (USA). Dept. of Zoology). 1979. Contract EY-76-S-05-3631. 94p. Dep. NTIS, PC A05/MF A01.

Special work during the year concentrated on induced repair of cellular radiation damage in a number of strains of Escherchia coli. Ultraviolet and x-radiation are considered for induction of cell damage. (PCS)

BASIC STUDIES

REFER ALSO TO CITATION(S) 55594

VACCINE PREPARATION AND OTHER APPLICATIONS

REFER ALSO TO CITATION(S) 55177

RADIATION EFFECTS ON PLANTS

55598 **Influence of radiation exposure rate on somatic mutation frequency and loss of reproductive integrity in Tradescantia stamen hairs.** Ichikawa, S.; Nauman, C.H.; Sparrow, A.H.; Takahashi, C.S. (Brookhaven National Lab., Upton, NY). *Mutat. Res.;* **52**: 171-180(1978).

Inflorescences of Tradescantia clone 02 ($2n = 12$), hetero- or hemi-zygous for flower color, were exposed to a series of γ-ray exposures at two different exposure rates, 29.3 R/min and 0.026-0.52 R/min. Pink mutation-response curves and survival curves based on reproductive integrity were constructed for each of the exposure rates. Loss of reproductive integrity was also assessed at high (256 R/min) and low (0.52-4.17 R/min) γ-ray exposure rates in T. blossfeldiana ($2n = 72$). All observations were made on stamen hairs. The higher exposure rate was 1.3 to 1.7 times more effective in inducing pink mutations in clone 02. A greater efficiency of the higher exposure rate was also found for both taxa at the loss of reproductive integrity endpoint. The D_0 values obtained at the higher exposure rates, 154 R for clone 02 and 720 R for T. blossfeldiana, were significantly lower than the corresponding values of 270 R and 1880 R obtained at the lower exposure rates. These D_0's differ by factors of 1.75 and 2.61 for clone 02 and T. blossfeldiana, respectively. D_0's for the two taxa were found to be inversely correlated with their interphase chromosome volumes.

BASIC STUDIES

55599 (DOE/EV/00637—8) **Development of new techniques of using irradiation in the genetic improvement of warm season grasses, the assessment of their genetic and cytogenetic effects and biomass production from grass. Progress report, November 1, 1978-October 31, 1979.** Burton, G.W.; Hanna, W.W. (Georgia Univ., Athens (USA)). Jun 1979. Contract EY-76-S-09-0637. 43p. Dep. NTIS, PC A03/MF A01.

The following topics are discussed: altering protein quantity and quality in pearl millet grain by irradiation and mutation breeding; effect of nitrogen and genotype (male and female) on pearl millet grain; irradiation breeding of sterile triploid turf bermudagrasses; irradiation breeding of sterile Coastcross-1, a forage grass hybrid to increase winterhardiness; heterosis resulting from crossing specific irradiation induced mutants with their normal inbred parent; economic assessment of irradiation induced mutants; use of ethidium bromide to create cytoplasmic male sterile mutants in pearl millet; use of mitomycin and streptomycin to create cytoplasmic male sterile mutants in pearl millet; biomass of napiergrass; evaluation of mutagen induced lignin mutants in sorghum; interspecific transfer of germplasm using gamma radiation; production of homozygous translocation tester stocks; use of radiation to control the reproductive behavior in plants; genetics of radiation induced mutations; response of pearl millet pollen to gamma radiation; and nature of morphological changes in sterile triploid bermudagrass on golf courses.

55600 (IDO—12087, pp 167-170) **Reexamination of permanent vegetation plots at the Idaho National Engineering Laboratory Site.** French, N.R. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Data on plant density, frequency, and cover collected from permanent quadrats in five years over a 20-year period are being analyzed to determine the importance of climatic variables, the associations of different species of plants, and the effects of grazing and of periodic low level radioactive contamination on plant production of these quadrats. Preliminary results indicate that April precipitation affects production of certain grasses, while April temperatures are important to cactus. Analyses are continuing.

RADIATION EFFECTS ON ANIMALS

55601 (COO—2874-51) **Design for low dose extrapolation of carcinogenicity data. Technical report No. 24.** Wong, S.C. (Stanford Univ., CA (USA). Dept. of Statistics). Jun 1979. Contract EY-76-S-02-2874. 145p. Dep. NTIS, PC A07/MF A01.

Parameters for modelling dose-response relationships in carcinogenesis models were found to be very complicated, especially for distinguishing low dose effects. The author concluded that extrapolation always bears the danger of providing misleading information. (PCS)

MAN

55602 (BNL—51003) **External exposure measurements at Bikini Atoll.** Greenhouse, N.A.; Miltenberger, R.P.; Lessard, E.T. (Brookhaven National Lab., Upton, NY (USA)). Jan 1979. Contract EY-76-C-02-0016. 27p. Dep. NTIS, PC A03/MF A01.

External exposure rate surveys from 1975 to 1977 on the islands Nam, Eneu and Bikini of Bikini Atoll gave average external exposure rates of 24, 5.7, and 32 μR/hr respectively. The exposure rate on Eneu Island is uniform, whereas those on Bikini and Nam range from 7.0 to 80. μR/hr. Based on an assumed living pattern at Bikini Island, the adult male Bikinian is estimated to be in the presence of an external radiation field corresponding to 16 μR/hr due to debris and fallout from the 1954 BRAVO incident. This corresponds to a 30 year dose equivalent of 2.8 rem.

55603 (WAPD-TM—1275) **AIRWAY: a fortran computer program to estimate radiation dose commitments to man from the atmospheric release of radionuclides.** Rider, J.L. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jun 1979. Contract EY-76-C-11-0014. 195p. Dep. NTIS, PC A09/MF A01.

The AIRWAY computer program was developed to estimate the radiation dose commitments accured by all the people affected by the atmospheric release of radionuclides from a nuclear facility. This computer program provides dose commitment estimates for people on the boundary of the facility, in the immediate vicinity (i.e., within 80 to 100 km) and in the portios of the world beyond the

immediate vicinity which are affected by the release. The AIRWAY program considers dose commitments resulting from immersion in the atmosphere containing the released radionuclides, ingestion of contaminated food, inhalation of gaseous and suspended radioactivity, and exposure to ground deposits. The dose commitments for each of these pathways is explicitly calculated for each radionuclide released into the atmosphere and for each daughter of each released radionuclide. This is accomplished by calculating the air and ground concentrations of each daughter in each of the regions of interest using the release rate of the parent radionuclide. The AIRWAY computer program is considered to be a significant improvement over other programs in which the effect of daughter radionuclides must be approximated by separate releases.

VERTEBRATES

REFER ALSO TO CITATION(S) 55595

55604 (CONF-790524—10) **Radiation-induced dominant skeletal mutations in mice: mutation rate, characteristics, and usefulness in estimating genetic hazard to humans from radiation.** Selby, P.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From 6. international congress symposium on radiation research and stem cells; Tokyo, Japan (13 May 1979).

The work discussed in this paper represents a major advance in the difficult task of trying to estimate the effects that an increase in mutation frequency would have on human health. Male mice were bred to three females prior to being killed and skeleton studies made. Guidelines were instituted for checking progeny mutations. Surprising results showed a mutation frequency of 1.4% per gamete where none would have been expected. It is now clear that mice can be greatly deformed without showing external effects. (PCS)

55605 (IDO—12087, pp 99-107) **Systemic effects of radiation exposure on rodents inhabiting liquid and solid radioactive waste disposal areas.** Evenson, L.M.; Olson, D.P.; Halford, D.K.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

The potential effects of chronic radiation exposure on small mammals inhabiting a dry radioactive leaching pond at the Test Reactor Area (TRA) of the Idaho National Engineering Laboratory (INEL) were investigated. The principal mammal being investigated is the white-footed deer mouse (Peromyscus maniculatus). Previous studies have been conducted on the dry bed to determine the dose rates and the types and levels of radionuclides present. In 1978, the study was expanded to include the effects of radiation on deer mice inhabiting a radioactive solid waste burial site located at the Radioactive Waste Management Complex (RWMC). Whole blood was collected from the retro-orbitol space of each animal for complete blood count (CBC) studies and serum protein analyses to determine whether radiation exposure resulted in pathologic changes in the hematopoietic system. They were then sacrificed and vital and reproductive organs were examined grossly and microscopically for the presence of tumors and other pathological lesions. The spleens were aseptically removed, weighed, and processed for identification of possible damage to chromosomes of lymphocytes. Preliminary data revealed no evidence of pathologic changes in mice from the TRA that could be attributed to radiation exposure but there may be damage in the RWMC mice.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

55606 **Nasal carcinomas in beagles after inhalation of relatively soluble forms of beta-emitting radionuclides.** Benjamin, S.A.; Boecker, B.B.; Cuddihy, R.G.; McClellan, R.O. (Inhalation Toxicology Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *J. Natl. Cancer Inst.;* **63**: No. 1, 133-139(Jul 1979).

Beagles were exposed by inhalation to relatively soluble forms of single beta-emitting radionuclides and are being held for life-span observation to evaluate biologic hazards associated with nuclear power production. The dogs were exposed to graded activity levels of $^{91}YCl_3$, $^{144}CeCl_3$, or $^{90}SrCl_2$. With $^{91}YCl_3$ and $^{144}CeCl_3$, a significant radiation dose was delivered to the respiratory tract, liver, and skeleton. With $^{90}SrCl_2$, the dose was almost totally to the skeleton. Squamous cell carcinomas associated with the nasal cavity have been the most frequently observed neoplasms in the $^{91}YCl_3$ study and one of the most frequent in the $^{144}CeCl_3$ study, whereas few squamous cell carcinomas have been seen in the $^{90}SrCl_2$ study. One hemanglosarcoma in the nasal cavity was also seen in the ^{144}Ce study. The incidence of nasal carcinomas may be related to higher relative concentrations of the radionuclides ^{91}Y and ^{144}Ce associated with the nasal turbinates. This relatively high risk of nasal cavity neoplasms suggests that standards for human exposure to these radionuclides should include a consideration of the nasal cavity epithelium as a major target tissue.

ANIMALS

REFER ALSO TO CITATION(S) 55609

NUCLIDE KINETICS AND TOXICOLOGY

REFER ALSO TO CITATION(S) 55542, 55543

MAN

REFER ALSO TO CITATION(S) 55518, 55578, 55579, 55606, 55610, 55614

55607 (DPSPU—79-30-8) **Management of potential transuranium assimilation cases.** Johnson, N.D.; Ratchford, D.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1979. Contract EY-76-C-09-001. 18p. (CONF-790728—2). Dep. NTIS, PC A02/MF A01.

From 24. annual meeting of the Health Physics Society; Philadelphia, PA, USA (7 Jul 1979).

This review deals primarily with the duties of Health Protection personnel assigned to Savannah River's operatig facilities - as opposed to the role of bioassay and dosimetry specialists - in handling potential transuranium assimilation cases. (PCS)

55608 **Application of radiolead to metabolic studies.** Holtzman, R.B. (Argonne National Lab., IL). pp 37-96 of Biogeochemistry of lead in the environment. Nriagu (ed.). New York, NY; Elsevier/North-Holland Biomedical Press (1978).

Studies on the metabolism of radiolead are reviewed. ^{203}Pb is particularly useful because of its moderate half-life, low toxicity, and gamma-ray emissions that make it possible to observe its activity in vivo external to the body with gamma-ray emissions that make it possible to observe its activity in vivo external to the body with gamma-ray detectors. ^{212}Pb is somewhat less useful because of its shorter half-life and higher toxicity due to the alpha-particle emitters in its decay chain. Because lead is removed only very slowly after incorporation into the body with a half-life of many years, the 22-yr ^{210}Pb is of particular use. Just because of its long half-life and its toxicity due to its alpha-particle-emitting daughter, it can probably not be deliberately administered to humans. To work at sub-toxic levels in which radiation damage does not affect metabolism, only limited amounts may be administered to animals. It is difficult to study because it emits only a low-energy, low-intensity gamma-ray (47 keV in 5% of the disintegrations). It has been possible to derive many metabolic parameters from studies of occupationally and medically contaminated people, uranium miners, radium dial painters, chemists and radium patients. Other groups, such as reindeer and caribou meat eaters are possible study groups, but because of physical isolation, cultural problems, and the small populations involved, their use is highly limited. ^{210}Pb has been particularly useful in moderate to long-term experimental animal studies with beagles, baboons, and with rats. These studies are of special interest since they represent the long-term metabolism of lead as compared to the short-term studies involving the short-lived isotopes and are more analogous to the behavior of stable lead whose effects become manifest over relatively long periods of time. Studies on plants have been less extensive than on animals and man. (JGB)

ANIMALS

REFER ALSO TO CITATION(S) 55515, 55517, 55519, 55545, 55578, 55605, 55614

55609 (IDO—12087, pp 1-14) **Barn swallows nesting near radioactive leaching ponds in southeastern Idaho.** Millard, J.B.; Whicker, F.W.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Seasonally occurring populations of barn swallows nest near the Test Reactor Area (TRA) radioactive leaching ponds on the Idaho National Engineering Laboratory (INEL) Site. These birds utilize leaching pond arthropods and are therefore capable of accumulating radioactive materials and exporting them from the INEL Site during migration. The breeding biology is discussed for these swallows and a control group located 100 km away. Total nestling mortality for the controls and a 1977 TRA population was found to be statistically identical. Over 20 fission and activation products have been detected in immature and adult TRA birds. Mean concentrations of detectable radionuclides were used to calculate internal dose rates, and results showed that Na-24 contributed about 72% of the total average of 21.9 mrad/d for adult birds. Concentration factors

were also calculated for predominant radionuclides in swallows relative to filtered pond water. Data from LiF dosimeters in swallow nests constructed with contaminated mud indicated average dose rates were 84 mrad/d for eggs and 220 mrad/d for nestlings. Growth curves were constructed for the immature TRA birds and controls. The first clutch of TRA swallows was found to have a significantly lower mean growth rate constant than the first clutch of controls. The statistical difference in growth rate between the control and TRA first clutch populations may have resulted from differences in climate, nesting site habitat, or available food sources, and cannot be solely attributed to radiation exposure as a causative factor. Growth rate parameters for TRA birds were within the range of values reported in the literature.

55610 (IDO—12087, pp 47-55) **Radionuclide concentrations in wild waterfowl using the test reactor area radioactive leaching pond.** Halford, D.K.; Millard, J.B.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Waterfowl use the Test Reactor Area (TRA) Radioactive Leaching Pond on the Idaho National Engineering Laboratory Site (INEL Site) as a resting area. Daily observations of waterfowl were made to determine species composition and numbers. Eight ducks and one coot were collected from the TRA pond during 1976 and 1977. Seven background samples were also collected. Each bird was dissected and tissue samples were analyzed for gamma-emitting radionuclides. Duck tissues contained 25 radionuclides. Average and maximum radionuclide concentrations were highest in gut followed by feathers, liver, and muscle, Chromium-51 had the highest concentrations of all radionuclides identified 130,000 pCi/g (4800 Bq/g) in the gut and 37,500 pCi/g (1390 Bq/g) on the feathres). Neodymium-147 had the highest concentration on feathers of any radionuclide (104,000 pCi/g, 3850 Bq/g). Cesium-137 was the predominant radionuclide in muscle with a maximum concentration of 4,070 pCi/g (150 Bq/g). The ducks had lower radionuclide concentrations in the edible tissues than in the non-edible tissues. Potential whole-body and thyroid dose commitments to man consuming contaminated ducks were calculated using muscle concentrations of Cs-134, Cs-137, and I-131. Although assumptions used for dose calculations maximized the dose commitment to man, results indicated that consumption of contaminated duck tissue is not a radiation hazard to humans. Even the highest dose commitments were below the limits recommended for individuals of the general population by the Internatioal Commission on Radiological Protection (ICRP). The highest potential dose commitment to man would result from the consumption of an American coot known to have spent 20 days on the TRA pond. The average dose commitment to man would be 20 mrem.

55611 (IDO—12087, pp 56-63) **Retention of activation and fission radionuclides by mallards from the Test Reactor Area radioactive leaching pond.** Halford, D.K.; Millard, J.B.; Schreckhise, R.G. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Twenty semi-wild mallard ducks were banded, fitted with dorsal and ventral thermoluminescent dosimeter packets, and released on the Test Reactor Area radioactive leaching ponds. Ducks were live captured after 75 days and 145 days on the pond, placed in metabolic cages and whole-body counted periodically for 52 days. Ducks from each group were sacrificed immediately after capture, dissected, and muscle, feather, gut, and liver samples submitted for analyses. The remaining ducks were also sacrificed and dissected after the 52 day counting period. Concentrations of the 17 gamma emitting radionuclides detected at capture and after 52 days of physical and biological decay were compared. Highest mean radionuclide concentrations were found in feathers followed by gut, liver, and muscle. Effective and biological halflives of Zn-65, Cr-51, Cs-134, Cs-137, and Se-75 were determined and compared with data from previous studies. Samples are currently being analyzed for Pu-238, Pu-239-240, Am-241, Cm-242, Cm-244 and Sr-90. Further data analyses will be completed after data collection has terminated.

55612 (IDO—12087, pp 64-66) **Confinement device for the determination of wholebody radionuclide concentrations in live ducks.** Morton, J.S.; Halford, D.K.; Parker, D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Wholebody counts of live animals often involve irregularly shaped specimens which have to be confined to prevent changing geometries during the count and between analyses while precluding possible injury to the specimen. An additional problem results when the distribution of radionuclides within a live specimen is not homogeneous, as is often the case, or when the distribution within the body changes with time. A mechanically rotating device is described which assures reproducible counting geometries, eliminates movement during the count, and reduces the problem of inhomogeneity.

55613 **DL-[carboxyl-^{11}C]tryptophan, a potential agent for pancreatic imaging; production and preclinical investigations.** Washburn, L.C.; Sun, T.T.; Byrd, B.L.; Hayes, R.L.; Butler, T.A. (Oak Ridge Associated Universities, TN). Contract W-7405-ENG-26. *J. Nucl. Med.;* 20: No. 8, 857-864(Aug 1979).

In animal studies, DL-[carboxyl-^{14}C]tryptophan [DL-Try(C-14)] showed a high specificity for the pancreas, which suggested the potential of DL-[carboxyl-^{11}C]tryptophan [DL-Try(C-11)] for clinical pancreatic imaging. The blood clearance and tissue uptake of the amino acid were very rapid, and no carrier effect was observed through a dose of 5 mg/kg. None of three transplanted hamster pancreatic adenocarcinomas that we studied showed a selective uptake of DL-Try(C-14) by the tumor, and none of the three enzymatic regimens investigated gave significant enhancement of the pancreatic specificity. Commercial L-Try(C-14) gave slightly better pancreatic specificity than the analogous racemic compound but without enough improvement to warrant attempts at optical resolution. DL-Try(C-11) was synthesized in amounts up to 325 mCi using a rapid, high-temperature, high-pressure modification of the Buecherer-Strecker amino acid synthesis. Yields ranged from 30 to 60%, and a total of 40 min was required for synthesis and chromatographic purification. DL-Try(C-11) thus appears to have significant potential as a clinical pancreas-imaging agent, particularly when used in conjunction with positron computerized transaxial tomography.

PLANTS

REFER ALSO TO CITATION(S) 55518

55614 (IDO—12087, pp 108-114) **Iodine-129 relations in vegetation at the Idaho National Engineering Laboratory Site.** McGiff, T.J.; Fraley, L.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

A system was developed for the analysis of I-129 concentrations and I-129 to I-127 atom ratios in environmental vegetation samples at the INEL Site. The process involved a carrier-free separation of the iodine from the bulk sample via dry oxidative combustion and collection of the iodine on activated charcoal. This was followed by isotopic analysis for I-129 and I-127 using neutron activation techniques. The process is now being applied to samples of big sagebrush and several grass species which have been collected at various locations over the INEL Site. Results of this study will increase the understanding of the radioecology of I-129 and enhance the reliability of estimates of I-129 concentrations in thyroid and muscle tissues of antelope, cattle, and sheep which graze within and adjacent to the INEL Site.

55615 (IDO—12087, pp 115-128) **Seasonal variations in deposition and retention of cerium-141 and cesium-134 in Sitanion hystrix and Artemisia tridentata.** Millard, G.C.; Fraley, L. Jr.; Markham, O.D. Dec 1978.

In Ecological studies on the Idaho National Engineering Laboratory Site. 1978 progress report.

Deposition velocities and retention times were obtained for Cs-134 (a biologically active nuclide) and Ce-141 (biologically inactive) on a shrub species and a grass. Submicron aerosols of these two nuclides were artificially generated and released over a sagebrush community in southeast Idaho during each of three seasons: spring, summer, and winter, in order to study the effects of weathering and plant development. Vegetation samples were collected immediately following each release and at regular intervals thereafter to obtain retention data. Air concentrations were obtained for deposition velocity calculations. Information on friction velocities, roughness lengths, and particle size was also obtained. A comparison of spring and summer deposition velocity and retention halftime data showed no statistically significant difference between nuclides, however species differences were significant. Grass deposition velocities were 0.02 cm/s in spring and 0.07 cm/s in summer. Shrub values were 0.15 cm/s in spring and 0.18 cm/s in summer. Retention data indicated a rapid initial loss (halftime of 1 to 2 days) followed by a slower loss (halftimes of several weeks).

THERMAL EFFECTS

55616 (DP-MS—79-8) **Periphyton responses to nutrient enrichment and elevated temperatures in a low pH South Carolina stream: effects on biomass and productivity.** Brown, D.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 19 Jun 1979. Contract EY-76-C-09-0001. 17p. (CONF-7906107—1). Dep. NTIS, PC A02/MF A01.

From American Society of Limnolgy and Oceanography conference; Stony Brook, NY, USA (19 Jun 1979).

The interactive effects of elevated temperatures and nutrient enrichment on periphyton communities on glass slides were studied for one year in the Flowing Streams Laboratory, operated by Savannah River Laboratory (SRL) for the Department of Energy

(Figure 1). Water from a South Carolina stream called Upper Three Runs, characterized by low pH and low nutrient concentrations and with intermittent swamp drainage, was used.

PLANTS

55617 (DP-MS—79-17) **Periphyton responses to nutrient enrichment and elevated temperatures in a low pH South Carolina Stream II. Effects on community composition.** Brown, D.C. (South Carolina Univ., Columbia (USA). Dept. of Biology; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 17p. (CONF-790846—1). Dep. NTIS, PC A02/MF A01.

From American Institute of Biological Science conference; Stillwater, OK, USA (13 Aug 1979).

The present study examined the effects of both elevated temperatures and added nutrients on periphyton communities. The basic question was, what are the effects of temperature and nutrient modifications on periphyton communities.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 55484, 55550, 55576

CELLS

55618 (UCRL—83185) **Application of a battery of short-term bioassays for testing and genetic toxicity of Paraho shale oil products.** Hatch, F.T.; Timourian, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-36. 23p. (CONF-7904109—1). Dep. NTIS, PC A02/MF A01.

From EPA/ORNL synfuel meeting; Triangle Park, NC, USA (26 Apr 1979).

The relative mutagenicity and genetic toxicity of crude, hydrotreated, and refined shale oil products from the Paraho surface retort are to be determined and their potential health hazards compared with similar materials derived from petroleum. This will be done by applying a battery of bioassays consisting of a standard microbial test and in vitro and in vivo mammalian systems to obtain a basis for estimating health hazards to humans.

MICROORGANISMS

REFER ALSO TO CITATION(S) 55618, 55626

55619 (DOE/EV/04024—6) **Effect of radiation-sensitive mutations and mutagens/carcinogens on bacterial recombination and mutagenesis. Progress report.** Matney, T.S. (Texas Univ., Houston (USA). Health Science Center). 1978. Contract DE-AS05-76EY04024. 10p. Dep. NTIS, PC A02/MF A01.

Progress is reported on effects of temperature sensitive DNA-initiation mutation in E. coli K-12 mutants; the use of Bacillus subtilis transforming system as an in vitro mutagenesis system; characteristics of the E. coli lysogen used to test the permeability to polycyclic aromatic hydrocarbons; and the genetic toxicology of gentian violet. (PCS)

55620 (LBL—9037, pp 177-186) **Structure-activity relationships in polynuclear aromatic hydrocarbons.** Hecht, S.S.; LaVoie, E.J.; Hoffmann, D. (American Health Foundation, Valhalla, NY). Jun 1979.

From Conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (20 Mar 1978).

Current concepts on the metabolic activation and carcinogenicity of polynuclear aromatic hydrocarbons are reviewed. A major process in metabolic activation of some common PAH carcinogens, such as benzo(a)pyrene, benz(a)anthracene, and chrysene and their methylated derivatives is apparently formation of angular ring diol-epoxides in which one carbon terminus of the epoxide is in a bay region position. Among the four to six ring unsubstituted PAH, one structural requirement for carcinogenicity is a free peri position adjacent to an angular ring. Substitution of a methyl group in the angular ring may decrease carcinogenicity while substitution at other positions may increase carcinogenicity, especially when the molecule becomes non-planar. Three bioassay systems - complete carcinogenicity and tumor initiation on mouse skin, and mutagenesis in S. typhimurium TA 100 - were compared for certain PAH derivatives. Complete carcinogenicity assays were the most sensitive to minor structural changes. Tumor initiation and mutagenicity assays had the advantages of lower material requirements and more rapid results.

55621 **Literature survey of bacterial, fungal, and Drosophila assay systems used in the evaluation of selected chemical compounds for mutagenic activity.** Brown, M.M. (Oak Ridge National Lab., TN); Wassom, J.S.; Malling, H.V.; Shelby, M.D.; Von Halle, E.S. Contract W-7405-ENG-26. *J. Natl. Cancer Inst.;* 62: No. 4, 841-871(Apr 1979).

Literature reports were surveyed, with results noted from experiments in seven nonmammalian assay systems used for the detection of mutagenicity or other related genetic effects. A comparison was made of the activities of 54 selected noncarcinogens, procarcinogens, and ultimate carcinogens as revealed by these test systems. Of the compounds tested, 49 (91%) were active in one or more of the assays, and 42 (78%) were positive in at least one system without having to be metabolically activated. In one or more test systems, 17/17 (100%) of the ultimate carcinogens, 27/28 (96%) of the procarcinogens, and 6/9 (67%) of the noncarcinogens were positive. The Ames Salmonella-microsome assay responded with increased mutation frequency to 37/44 (84%) of the carcinogenic compounds but to only 2/8 (25%) of the noncarcinogens tested. The Drosophila system responded to 19/21 (90%) of the carcinogens and to 3/6 (50%) of the noncarcinogens. Prophages were induced when lysogenic bacteria were exposed to 12/21 (57%) of the carcinogens, but not enough tests were done with the noncarcinogens (1/3, or 33%) for a comparison. The other systems reviewed, such as the killing of repair-deficient bacteria, mutations in Escherichia coli and Neurospora crassa, and the host-mediated assay, were not challenged by enough of the compounds for valid comparisons.

PLANTS

REFER ALSO TO CITATION(S) 55177, 55617

55622 **Daytime variations of ozone eddy fluxes to maize.** Wesely, M.L.; Eastman, J.A.; Cook, D.R.; Hicks, B.B. (Argonne National Lab., IL). *Boundary-Layer Meteorol.;* 15: 361-373(1978).

The vertical fluxes of ozone, momentum and heat in the atmospheric surface layer have been measured by eddy correlation above both mature and senescent maize canopies. Aerodynamic formulae are applied to find that the bulk canopy surface resistance r/sub c/ to ozone uptake and destruction varies between 4.0 and 0.5 s cm^{-1} during the daytime. Apparently, surface properties tend to control the removal of ozone at the surface of the earth. For a lush canopy, the stomatal diffusion resistance is the most important property, while changes in surface temperature have little effect. Destruction at the soil and exterior plant surfaces appears to account for 20 to 50% of the total loss if leaf mesophyll resistances are assumed to be very small. Free water at leaf surfaces may at times inhibit ozone removal by both senescent and healthy plants.

INVERTEBRATES

REFER ALSO TO CITATION(S) 55621

VERTEBRATES

REFER ALSO TO CITATION(S) 55618, 55620

55623 (LA—7967-MS) **Acute toxic effects of two crude shale oils and two standard petroleum crude oils applied to mouse skin.** Wilson, J.S.; Holland, L.M. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

The acute dermal toxicity of two crude shale oils and two crude petroleums was studied, in an effort, to establish threshold tolerance levels for use in a subsequent epidermal carcinogenesis experiment. Five dose levels of each test oil were applied daily to the skin of C3Hf/He mice for two weeks. At the end of the two week treatment period all mice were humanely sacrificed and histological sections of the skin were examined for inflammatory changes. Representative tissues from major organ systems were also examined for signs of systemic toxicity. Neither of the reference petroleum crude oils caused severe inflammation, while both shale oils caused marked inflammation accompanied by ulceration at the higher dose levels.

55624 (LA—7983-PR) **Detection of early changes in lung cell cytology by flow-systems analysis techniques. Progress report, January 1-June 30, 1979.** Steinkamp, J.A.; Wilson, J.S.; Svitra, Z.V. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

This report summarizes results of ongoing experiments designed to develop automated flow-analysis assay methods for discerning damage to exfoliated respiratory tract cells in model test animals exposed by inhalation to physical and chemical agents associated with the production of synthetic fuels from oil shale and coal, the specific goal being the determination of atypical changes in exposed alveolar macrophages and epithelial cells. Animals were exposed to oil shale particles (raw and spent), silica, and polystyrene latex spheres via intratracheal instillation. Respiratory tract cells were obtained by lavaging the lungs with normal saline, stained with mithramycin for DNA content, and analyzed using flow cytometric analysis methods. In addition to measuring DNA content, differen-

tial and total cell counts were made on all samples analyzed. DNA content frequency distribution histograms and cytology showed definite atypical changes resulting from exposure to shale and silica particulates when compared to the controls. To continue development of fluorescence staining methods for measuring intracellular enzymes in alveolar macrophages, studies were initiated for determining β-glucuronidase using naphthol AS-BI-β-d-glucuronic acid as a fluorogenic substrate. As this new technology becomes adapted to analyzing pulmonary macrophages and epithelial cells, the measurement of physical and biochemical properties as a function of exposure to particulate and gaseous toxic agents related to the production of synthetic fuels will be increased. This analytical approach is designed to assist in the establishment of future guideline for estimating the risks to exposed humans.

55625 (UR—3490-1657) **Developmental changes in mouse: mercury retention, metabolism, and excretion after methylmercuric chloride administration.** Landry, T.D. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 215p. Dep. NTIS, PC A10/MF A01.

Thesis.

The developmental change in Hg retention after MeHgCl administration has been characterized in terms of timing, dosage effects, tissue distribution, routes of Hg excretion, and form of Hg excreted. Age-dependent changes in MeHg demethylation and fecal Hg excretion have been observed. These developmental changes in distribution and excretion affect MeHg risk assessment, and provide insights into possible mechanisms of MeHg metabolism and excretion.

55626 Mutagenic activity of chemical carcinogens and related compounds in the intraperitoneal host-mediated assay. Simmon, V.F. (Stanford Research Inst., Menlo Park, CA); Rosenkranz, H.S.; Zeiger, E.; Poirier, L.A. *J. Natl. Cancer Inst.;* **62**: No. 4, 911-918(Apr 1979).

The mutagenic activities of 79 carcinogens, noncarcinogens, and structurally related compounds toward Salmonella typhimurium strains TA1530, TA1535, and TA1538 and toward Saccharomyces cerevisiae D3 were investigated in the intraperitoneal host-mediated assay. Fewer than half of the carcinogens were mutagenic toward the Salmonella strains. The insensitivity of the system was most marked with the aromatic amine and polycyclic hydrocarbon procarcinogens. Under the test conditions, fewer than 10% of the carcinogens showed clear mutagenic activity toward S. cerevisiae D3. However, none of the noncarcinogens was significantly mutagenic toward either S. typhimurium or S. cerevisiae D3. Overall, the intraperitoneal host-mediated assay does not seem suitable for routine preliminary screening of large numbers of potential carcinogens. The median lethal doses to mice of 46 compounds were determined.

55627 Lack of involvement of 6-hydroxymethylation in benzo[a]pyrene skin tumor initiation in mice. Slaga, T.J. (Oak Ridge National Lab., TN); Bracken, W.M.; Viaje, A.; Berry, D.L.; Fischer, S.M.; Miller, D.R. *J. Natl. Cancer Inst.;* **61**: No. 2, 451-455(Aug 1978).

The skin tumor-initiating activities of benzo[a]pyrene (BP), 6-hydroxymethylbenzo[a]pyrene (6-OH-CH_3-BP), and 6-methylbenzo[a]pyrene (6-CH_3-BP), as well as the effects of 7,8-benzoflavone (7,8-BF), quercetin, and 1-benzylimidazole on their activity, were determined in outbred female CD-1 mice by use of a two-stage system of tumorigenesis. The skin tumor-initiating activity of 6-OH-CH_3-BP and 6-CH_3-BP was 12.5 and 20%, respectively, of the activity of BP. 7,8-BF had little effect on the skin tumor-initiating activity of 6-OH-CH_3-BP and 6-CH_3-BP. However, a dose-dependent inhibition of BP tumorigenesis by 7,8-BF was noted. Quercetin and 1-benzylimidazole also inhibited BP skin tumor-initiating activity. These findings indicated that direct hydroxymethylation of BP is not an important pathway in the activation of BP in mouse skin tumor initiation.

55628 Postnatal changes in the anemic rat after exposure to Cd during gestation. Martin, P.G.; Hitchcock, B.B.; King, J.F. (Comparative Animal Research Lab., Oak Ridge, TN). pp 191-197 of Trace substances in environmental health. XII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1978).

From 12. conference on trace substances; Columbia, MO, USA (5 Jun 1978).

Iron deficient dams and pups were affected to a greater degree (decreased viability) by an acute oral dose of /sup 115/Cd (100 μmoles stable Cd) administered on day 18 of gestation than were comparable iron replete rats. Only 2 of the 6 Fe deficient feales receiving Cd produced living pups, 2 were unable to deliver and 2 died before term. Thirty percent of the pups from Fe deficient dosed dams died with 2 days after delivery. Viability was not affected in Fe replete pups from dosed dams, but weight was depressed compared to that of nondosed animals. Food intake of both groups of Cd treated females, was severely reduced immediately after dosing. Results are discussed in relation to Cd deposits in pups, disruption of embryonic nutrition, and interruption in production of reproductive hormones.

MAN

REFER ALSO TO CITATION(S) 55601, 55637

55629 (CAEC—009) **Identification of hazards in non-nuclear power plants.** Roman, W.S.; Israel, W.J.; Sacramo, R.F. (NUS Corp., Rockville, MD (USA)). Jul 1978. 237p. (NUS—3099). NUS Corp., Rockville, MD.

Public health and safety hazards have been identified for five types of power plants: coal-fired, oil-fired steam turbine, combined cycle, combustion (gas) turbine, and geothermal. The results of the analysis show that air pollutants are the major hazard that affects the health and safety of the general public. A total of ninety plant hazards were identified for the five plant types. Each of these hazards were rated in six categories as to their affect on the general public. The criteria used in the analysis were: area/population exposed; duration; mitigation; quantity to toxicity ratio; nature of health effects; and public attitude. Even though ninety hazards were identified for the five plants analyzed, the large majority of hazards were similar for each plant. Highest ratings were given to the products of the combustion cycle or to hydrogen sulfide emissions from geothermal plants. Water pollution, cooling tower effects and noise received relatively low ratings. The highest rated of the infrequent or hypothetical hazards were those associated with potential fires, explosions, and chlorine releases at the plant. Hazards associated with major cooling water releases, water pollution and missiles received the lowest ratings. Since the results of the study clearly show that air pollutants are currently considered the most severe hazard, additional effort must be made to further understand the complex interactions of pollutants with man and his environment. Of particular importance is the determination of dose-response relationships for long term, low level exposure to air pollutants. (EDB)

55630 (COO—2874-49) **Test for detection of clustering over time.** Wallenstein, S. (Columbia Univ., New York (USA). Dept. of Mathematical Statistics). Mar 1979. Contract EY-76-S-02-2874. 17p. Dep. NTIS, PC A02/MF A01.

The use of the scan statistic in testing for clustering in time is discussed with particular reference to a reported clustering of trisomies in spontaneous abortions in New York City (spontaneous abortions have been used on occasion to monitor environmental health effects). The scan statistic is the maximum number of observed cases in an interval of preselected length, as the interval is allowed to scan, or slide along, the time frame of interest. A table of the lower tail of the distribution of this statistic is given.

55631 (ORNL/TM—6955) **Program for the development of physical and biological concepts as a basis for health protection criteria for the exposure of humans to metals.** Turner, J.E.; Williams, M.W.; Jacobson, K.B.; Mitra, S.; Niyogi, S.K.; Witschi, H. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

Some preliminary ideas for a new program to develop physical and biological principles for possible use in formulating health protection criteria for exposure to metals are outlined.

55632 (UCRL—15057) **Utility functions and equity of public risk.** Keeney, R.L. (Woodward-Clyde Consultants, San Francisco, CA (USA)). 8 Aug 1979. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

With many large-scale projects, such as power plants, some members of the public will necessarily incur a risk. Public fatalities may result from either normal operations (e.g., via pollution) or accidents. Often in such cases, a small group of the public incur the risks, whereas a different group of the public receives the benefits from the project. In these circumstances, a major issue concerns the equity or fairness afforded members of the public. The concept of an equitable distribution of risk to address this issue was developed. Utility functions are found to be consistent with various basic value attitudes toward risk equity.

55633 Composite hazard index for assessing limiting exposures to environmental pollutants: formulation and derivation. Walsh, P.J.; Killough, G.G.; Rohwer, P.S. (Oak Ridge National Lab., TN). *Environ. Sci. Technol.;* **12**: 799-802(Jul 1978).

A calculational hazard index methodology was developed for limiting human exposure to environmental pollutants. Hazard index is defined as Q/Q/sub L/, where Q is a measure of exposure, such as an organ's burden of a pollutant from all environmental pathways, and Q/sub L/ is a corresponding limit that should not be exceeded because of health risk to human beings. Mathematical formulations relating hazard indices to environmental pollutant concentration were developed for each sampling medium corresponding to each effluent mode. These formulations are used to derive limiting pollut-

ant concentrations such that the resultant measure of exposure will not exceed the health risk limit. Mathematical formulations for composite hazard indices for multiple pollutants are presented.

55634 **$^{13}C/^{12}C$ ratio in black pulmonary pigment: a mass spectrometric study.** Slatkin, D.N. (State Univ. of New York, Stony Brook); Friedman, L.; Isra, A.P.; Gaffney, J.S. *Hum. Pathol.;* **9**: No. 3, 259-267(May 1978).

Ratio of the two stable isotopes of carbon, ^{13}C and ^{12}C, were measured in black pulmonary pigment and in several endogenous tissues removed during 20 autopsies on Long Island, New York. The mass spectrometer used for carbon isotope ratio analyses has a precision of +-1 ^{13}C atom per million carbon atoms. The $^{13}C/^{12}C$ ratio was found to be distinctly lower in black pulmonary pigment than in endogenous tissues, the mean difference amounting to 65 ^{13}C atoms per million carbon atoms. The results demonstrate that the elemental carbon fraction of black pulmonary pigment is exogenous and constitutes roughly 30 per cent of the weight of the pigmented material. It was also observed that $^{13}C/^{12}C$ ratios in endogenous tissues from individual autopsy cases were not quite identical, tending to be slightly greater in corpus callosum than in liver or peripheral lung.

55635 **Trace substances in environmental health. XII.** Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1978). 579p. (CONF-780631—).

From 12. conference on trace substances; Columbia, MO, USA (5 Jun 1978).

Papers are presented on the following subject categories: population studies; environmental geochemistry and health; health effects of trace substances; environmental pollution; and analytical methodology. Papers in scope for ERA/EDB were abstracted and indexed individually. (JGB)

55636 **Magnesium-calcium interrelationships in man.** Spencer, H.; Lesniak, M.; Gatza, C.A.; Kramer, L.; Norris, C.; Coffey, J. (Veterans Administration Hospital, Hines, IL). pp 241-247 of Trace substances in environmental health. XII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1978).

From 12. conference on trace substances; Columbia, MO, USA (5 Jun 1978).

Studies of magnesium metabolism were carried out in man during different calcium intakes ranging from 200 to 2000 mg/day and during an intake of 250 and of 850 mg Mg per day. During a dietary Mg intake of 250 mg/day and during a Mg intake of 850 mg/day, which was due to the intake of magnesium oxide, Mg balances were in equilibrium during all Ca intakes. Increasing phosphorus intake from 800 to 1400 mg/day during different Ca intakes also did not affect the Mg balance. During the high Mg intake urinary and fecal Mg increased markedly and the Mg balance became more positive in some, but not all, cases. Intravenous Mg as well as intravenous Ca increased urinary Mg and Ca while increased urinary Ca during metabolic acidosis caused by starvation was not associated with an increase of urinary Mg.

HEALTH AND SAFETY

55637 (CONF-790479—1) **Body burdens: an integrated approach to health risk assessment.** Gasper, J.R.; Dauzvardis, P.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From National conference on hazardous material risk assessment, disposal, and management; Miami Beach, FL, USA (25 Apr 1979).

Monitoring, modeling, and laboratory data are being integrated with physiological data in order to assess the impact of the release of environmental contaminants on the human receptor. The methodology described in this paper is intended primarily for use as a screening method to identify relative health risks. Comparison of body burdens and critical organ burdens can identify the relative contribution from different sources of exposure, exposure pathways, and routes of entry. These two burdens may be used in conjunction with monitoring data and environmental modeling techniques to assess the relative risk of effluent releases from natural and industrial sources or from different effluent control technologies or waste disposal methods. The relative impact of different levels of regional economic growth or regulatory plans can also be assessed. Body burdens may also serve to indicate where effluent control efforts will be most successful in reducing impacts on humans. The example projects the relative contributions to body burdens of arsenic, cadmium, chromium, mercury and lead resulting from background air and water quality, effluent releases from a coal-fired steam electric power plant, and from diet.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 54153, 55549

55638 (CONF-7906121—1) **Two-dimensional finite element solution for the simultaneous transport of water and solutes through a nonhomogeneous aquifer under transient saturated unsaturated flow conditions.** Gureghian, A.B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 33p. Dep. NTIS, PC A03/MF A01.

From Permiability and groundwater containment transport symposium; Philadelphia, PA, USA (17 Jun 1979).

A mathematical model of ground water transport through an aquifer is presented. The solute of interest is a metal tracer or radioactive material which may undergo decay through a sorbing unconfined aquifer. The subject is developed under the following headings: flow equation, solute equation, boundary conditions, finite element formulation, element formulation, solution scheme (flow equation, solute equation), results and discussions, water movement in a ditch drained aquifer under transient state, water and solute movement in a homogeneous and unsaturated soil, transport of ^{226}Ra in nonhomogeneous aquifer, tailings pond lined, and tailings pond unlined. It is concluded that this mathematical model may have a wide variety of applications. The uranium milling industry may find it useful to evaluate the hydrogeological suitability of their disposal sites. It may prove suited for the design of clay disposal ponds destined to hold hazardous liquids. It may also provide a means of estimating the long-term impact of radionuclides or other pollutants on the quality of ground water. 31 references, 9 figures, 3 tables.

55639 (RHO-BWI-C—42) **Preliminary investigation of the magnetostratigraphy of the Ringold Formation.** Packer, D.R.; Johnston, J.M. (Woodward-Clyde Consultants, San Francisco, CA (USA)). May 1979. Contract EY-77-C-06-1030. 57p. Dep. NTIS, PC A04/MF A01.

The Ringold Formation consists of lacustrine and fluvial deposits overlying the Columbia River Basalt. The Ringold Formation, because of its thickness, extent, and age, is an excellent unit in which to detect and possibly data the deformation that has occurred since deposition of the basalt. One objective of this study was to investigate the paleomagnetism of the upper Ringold unit exposed at one location in the White Bluffs in enough detail to resolve, with reasonable confidence, the magnetostratigraphy of the rock units sampled. The other objective was to evaluate, in a preliminary manner, the paleomagnetic favorability and magnetostratigraphy of the subsurface Ringold Formation in the Pasco Basin and at selected exposures outside the Pasco Basin. The scope of this study was the collection of 300 paleomagnetic samples, their measurement, and analysis. Samples were collected from the White Bluffs, from core recovered from six drill holes on the Hanford Site, and from two surface exposures outside the Pasco Basin. A total of 294 samples was collected, and 2928 paleomagnetic measurements were performed on these samples. The samples were measured by means of a three-axis super-conducting rock magnetometer having a sensitivity of 10^{-6} emu/cm^3 and were demagnetized progressively in a 400-hertz alternating field (AF). All data were recorded and processed during measurement by an on-line computer.The declination, inclination, and intensity of magnetization of the samples from the various sections are plotted as a function of their stratigraphic position. The directions of the magnetization of the various sections are also plotted as a group on Wulff equal-angle stereonets. 22 figures, 8 tables.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 54556

55640 **Attenuation patterns in the Pacific Northwest based on intensity data and the location of the 1872 North Cascades earthquake.** Malone, S.D.; Bor, S.S. (Univ. of Washington, Seattle). Contract EY-76-S-06-2225 TA 39. *Bull. Seismol. Soc. Am.;* **69**: No. 2, 531-546(Apr 1979).

Intensity data from 14 historic earthquakes in or near Washington State, as reported at over 300 localities, are used to study the attenuation structure in Washington. The empirical relation of Evernden [Bull. Seism. Soc. Am., 65, 1287-1313(1975)] is used to determine the size and depth for each earthquake and the local attenuation factor, k, for two physiographic parts of the state. The value for k in the Puget Sound region and north into Canada is 1 3/4, while k = 1 1/2 is more appropriate for eastern Washington and

northern Oregon. Individual amplification factors are computed for all localities at which four or more earthquakes have been felt by averaging the difference between the computed intensity and reported intensity at each site. Using these correction factors, the intensities for the North Cascade earthquake of 1872 are used to place constraints on its size and location. It appears this earthquake may be slightly larger (magnitude 7.4) and located south and west of the original epicenter determined by Milne. 7 figures, 4 tables.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 54519

55641 (UCRL—15073) **Laboratory measured material properties of quartz monzonite, Climax Stock, Nevada Test Site.** Pratt, H.R.; Lingle, R.; Schrauf, T. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jun 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

Properties of the Climax Stock quartz monzonite at the Nevada Test Site were measured. Test samples were obtained from the NX core of holes G1 and G2 or cored from larger cores obtained from the general area of the heater tests. Properties tabulated include physical properties, thermal properties, and mechanical properties (e.g. Young's modulus, dynamic Poisson's ratio, dynamic bulk modulus, tensile strength). The methods used in obtaining the data are described. 8 figures, 3 tables. (RWR)

55642 (VPI-SU—5648-3, pp B.59-B.65) **Origin of the Winnsboro granite by crustal anatexis.** Hanan, B.B. 1978.

In Evaluation and targeting of geothermal energy resources in the southeastern United States. Progress report, April 1, 1978-June 30, 1978.

Arguments against greywacke being the source of Winnsboro granite are presented. (MHR)

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 54187

PHYSICS RESEARCH

COSMIC RADIATION

REFER ALSO TO CITATION(S) 55673

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

55643 (SAND—79-0598C) **Sympathetic breakdown on gaps in air.** Brainard, J.P.; Andrews, L.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-791028—3). Dep. NTIS, PC A02/MF A01.

From Conference on electrical insulation and dielectric phenomena; Whitehaven, PA, USA (21 Oct 1979).

Sympathetic breakdown occurs when an electrical breakdown of one gap initiates the breakdown of another adjacent gap which is stressed below its normal breakdown level. Gap breakdown triggered by ultraviolet light did not seem like a sufficient explanation since the ultraviolet triggering discussed in the literature occurred at overstressed fields rather than reduced fields. The experiment described in this paper, however, demonstrates that ultraviolet light is responsible for sympathetic breakdown. A gap at a distance as great as 0.4 m from an initiating gap was found to sympathetically break down at fields as low as 55% of the normal breakdown field. Sympathetic breakdown occurred over a wide range of discharge currents from mA to kA. A relationship between the electric field in a gap and the breakdown initiation time after the introduction of ultraviolet light was determined.

BEAMS AND THEIR REACTIONS

55644 (ANL—79-41, pp 257-266) **Neutralization of positive particle beams by electron trapping.** Mobley, R.M.; Irani, A.A.; LeMaire, J.L.; Maschke, A.W.;. (Brookhaven National Lab., Upton, NY). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Experimental results of transverse space charge studies of a 720 keV, 60 mA H^+ beam in a drift region of 4.6 meters are presented. It is found that the observed change in transmission is consistent with complete neutralization in the drift pipe for grounded or negative electrodes, and with complete de-neutralization in the case of $>$ 240 V electrodes. It is also concluded that background gas ionization cannot be the main source of the neutralizing electrons.

55645 (ANL—79-41, pp 325-331) **Argonne National Laboratory heavy ion beam transport experiments with a 2 mA 80 keV Xe^{+1} source.** Mazarakis, M.; Price, D.; Watson, J. (Argonne National Lab., IL). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The critical dimensions of the Argonne heavy ion beam transmission experiments and the experimental set-up are considered. Experimental results of beam transmission and emittance measurements are discussed.

55646 (IPNO—78-01) **Electron beam density of CRYEBIS FRECH 2 electron gun.** Abd el Baki, M.; Goldstein, C. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1978. 19p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This report gives a method to calculate by computer-programming the FRECH II-electron beam density. This method consists in taking current measurements on a 1/10 mm tungsten-wire, to determine the electron-beam density profile.

55647 (SAND—79-1764C) **Critical analysis of the modified Firsov model II. Sensitivity to the average speed of atomic electrons.** Cruz, S.A.; Vargas, C.; Brice, D.K. (Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Fisica; Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-790843—7). Dep. NTIS, PC A02/MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

Cheshire's modification to the Firsov model for calculating the low-velocity electronic stopping cross section (S/sub e/) is shown to be highly sensitive to the use of an average ($<v>$) rather than a r.m.s. speed (v/sub rms/) for atomic electrons in the evaluation of S/sub e/. We demonstrate that a reduction by a factor of $\sim$ 1/2 in the predicted values for S/sub e/ is generally observed when one uses $<v>$ as prescribed by the original theory, instead of v/sub rms/ as is commonly used in the calculations. The results of this study are compared with experimental data for amorphous carbon targets as well as for channeling measurements in the $<110>$ direction for silicon crystals. A brief discussion is presented regarding the importance of the other factors that could affect the outcome of the calculations.

ATOMIC AND MOLECULAR PROPERTIES

55648 **Luminescence of U^{3+} in $LaBr_3$.** Hessler, J.P. (Argonne National Lab., IL (USA)); Hegarty, J.; Levey, C.G.; Imbusch, G.F.; Yen, W.M. (Wisconsin Univ., Madison (USA). Dept. of Physics). *J. Lumin.;* **18**: No. 19, 73-75(Jan 1979).

The luminescence behavior of the M-level of U^{3+} in $LaBr_3$ (18 388 cm^{-1}) has been studied with time resolved tunable dye laser techniques. Multiplesites have been detected. A unique site is identified; its inhomogeneous width and the temperature dependence of the fluorescence lifetime have been measured.

55649 **Applications of high resolution laser spectroscopy.** Haensch, T.W. (Stanford Univ., CA). pp 326-339 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

The uses of high resolution laser spectroscopy are reviewed, and applications of high resolution laser spectroscopy to the study of atomic hydrogen at Stanford University. Three nonlinear spectroscopic methods are discussed: Doppler-free two-photon spectroscopy, saturated absorption spectroscopy, and polarization spectroscopy. (GHT)

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

55650 (COO—3069-677, pp 325-340) **Reanalysis of electron scattering and muonic x-ray data for ^{208}Pb.** Frair, J.L.; Heisenberg, J.; Negele, J.W. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

A simultaneous analysis was performed for the world's supply of data on lead 208. A total of 14 sets of electron scattering data were analyzed along with six independent muonic transition energies. A previously used Fourier Bessel expansion program was expanded to include the full set of available data. The fit was done

starting with the density distribution and using 13 expansion coeffients with a cutoff radius of 11 fm. The results are tabulated for muonic energy levels. Interior charge densities of lead 208, differential cross sections, per cent of experimental deviation from the fit, and charge density are plotted. 8 references. (JFP)

55651 (LA—7903-PR, pp 49-50) **Studies of interactions of stopped muons with actinide nuclei.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Lifetimes of muonic ^{232}Th, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, and ^{242}Pu are tabulated. The time distribution of neutrons emitted from muonic ^{239}Pu is also shown; μ capture by fission fragments is indicated. 1 figure, 1 table. (RWR)

55652 (LA—7903-PR, pp 49-51) **Physics of the pion and the pionic atom.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Calculated and observed five—structure splitting of the 5-4 transitions in pionic Ti are tabulated. Effects of coulomb potential, vacuum polarization, strong interactions, and electron screening are included. A spectrum of π-Ti 5f—4d and 5g—4f transitions is also shown. 1 figure, 1 table (RWR)

55653 (LA—7903-PR, pp 54-55) **Perturbed circular polarization of muonic x rays.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

The negative-muon precession in palladium metal was observed for the first time, and the Knight shift was determined to be -90 +- 0.7% at 11K; there is thus a dramatically large hyperfine anomaly between μ^- Pd and its equivalent isotope RhPd; H/sub hf/(μ^- Pd)/H/sub hf/(RhPd) = 0.60 +- 0.05. The negative-muon precession technique was used to probe the hyperfine field in an itinerant magnetic system MnSi; the hyperfine coupling constant of μ^- Si in MnSi was determined to be -58.7 +- 1.1 kOe/μ/sub B/. 2 figures, 1 table.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 55841

55654 (ANL—79-41, pp 171-174) **Charge changing cross sections for Cs^+ + Cs^+ collisions.** Olson, R.E. (Molecular Physics Lab., Menlo Park, CA). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

An investigation of CS^+ + Cs^+ collision processes aimed at estimating the charge changing cross sections at energies on the order of 100 keV is reported. The studies indicate that this charge changing cross section will be primarily due to simple one electron ionization, not charge transfer.

55655 (ANL—79-41, pp 175-182) **Atomic cross sections for fast Xe/sup q+/ and U/sup q+/ ions colliding with atoms and molecules.** Gillespie, G.H. (Physical Dynamics, Inc., Berkeley, CA); Cheng, K.T.; Kim, Y.K. 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

A number of high-velocity, upper bound atomic cross sections for collisions of xenon and uranium ions with atoms and molecules are presented. Upper bound cross sections for ionization of H_2N_2, Li, and Ne targets by impact of fast Xe and U ions are given. A sum-rule formalism within the context of the Born approximation was used to calculate the cross sections.

55656 (ANL—79-41, pp 183-189) **Preliminary estimate of heavy ion electron-transfer cross sections.** Sramek, S.; Gallup, G.; Macek, J. (Univ. of Nebraska, Lincoln). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Preliminary estimates of cross sections for the electron transfer process $Ba^+ + Ba^+ \rightarrow Ba + Ba^{++}$ are reported for the energy range 100 to 300 keV. The relative motion of the heavy ions' nuclei can be treated as a classical motion along straight line trajectories. The molecular states of Ba_2^{++} are first obtained as functions of internuclear separation, treating the nuclei as stationary point charges. Then, the time-dependent Schroedinger equation is solved for the moving nuclei, using these molecular states as a basis.

55657 (ANL—79-41, pp 191-194) **Charge exchange cross sections for the reaction $Xe^{+8} + Xe^{+8} \rightarrow Xe^{+9} + Xe^{+7}$.** Macek, J. (Univ. of Nebraska, Lincoln). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The charge changing cross sections for self collisions of Xe^{+8} ions with 0 to 150 keV relative translational kinetic energy are estimated on the basis of the Fano-Lichten electron promotion model. It is concluded that for $Xe^{+8} + Xe^{+8}$, charge changing collisions occur only infrequently compared to excitation and with cross sections much smaller than 10^{-18} cm^2.

55658 (ANL—79-41, pp 195-200) **Low-lying states of $(Cs_2)^{++}$.** Das, G.; Raffenetti, R.C.; Kim, Y.K. (Argonne National Lab., IL). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Using an MCSCF/CI method, wave functions for the ground state $^1\Sigma^+$/sub g/ and the excited states of the symmetries ($^1\Sigma^+$/sub g/, ^{1}Pi/sub g/, and $^1\Delta$/sub g/) of the $(Cs_2)^{++}$ ion are generated which asymptotically correspond to the single atomic excitation and/or single electron transfer between the two Cs^+ ions in their ground state. These molecular wave functions are needed in the calculation of charge transfer cross sections between the Cs^+ ions. There are no curve crossings between the ground and excited states for internuclear separation of about 4 bohrs or more. It is inferred, therefore, that the charge transfer cross section is unlikely to exceed geometrical cross sections at low collision energies.

55659 (ANL—79-41, pp 201-207) **Charge exchange between singly ionized helium ions.** Choi, B.H. (Univ. of California, Riverside); Poe, R.T.; Tang, K.T. 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The plane-wave Born approximation was used to evaluate the charge transfer cross sections for the reaction $He^+ + He^+ \rightarrow He^{++} + He$. The charge transfer cross section is graphed as a function of incident energy and compared with experimental measurements.

55660 (CONF-790690—3) **Quantitative comparison of multiple-photon absorption in polyatomic molecules.** Judd, O.P. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 54p. Dep. NTIS, PC A04/MF A01.

From 4. international conference on laser spectroscopy; Rottach-Egern, Tegernsee, F.R. Germany (11 Jun 1979).

A quantitative comparison of multiple-photon absorption for a number of polyatomic molecules has been performed. A basis for this comparison has been developed that takes into account the different experimental conditions and molecular parameters, and provides suitable normalization of the fluence and absorption parameters. The normalization, and consequently the generalized interaction process can be specified in terms of the spectroscopic absorption cross section of the molecule $\sigma_0(\nu)$ and the effective fraction of molecules that interact with the radiation field $\langle f \rangle$. The results of the study indicate that in terms of the normalized absorption variables, multiple-photon absorption is a general phenomena that is qualitatively the same for all molecules; quantitative differences can be related to differences in σ_0 and $\langle f \rangle$. The absorption of all polyatomic molecules can be described in terms of the number of photons absorbed per molecule eta(PHI) at a fluence PHI. The data indicate that in spectral regions where $\sigma_0(\nu)$ greater than or equal to 0.1 σ_0 (max), eta(PHI) can be represented by the function PHI/sup γ/ where $\gamma = 1$ for σ_0PHI/$\langle f \rangle < 1$ and γ approx. = 2/3 for σ PHI/$\langle f \rangle > 1$. Quantitative values of $\langle f \rangle$ and the functional dependence of eta(PHI) on the experimental parameters such as gas pressure, optical bandwidth, and optical pulse duration are derived and shown to be in good agreement with experimental data for SF_6. These results are also compared with the anharmonic oscillator model for multiple-photon excitation of polyatomic molecules.

55661 (CONF-790843—5) **Transmission of fast molecular ions through thin foils.** Pietsch, W.J.; Gemmell, D.S.; Cooney, P.J.; Kanter, E.P.; Kurath, D.; Ratkowski, A.J.; Vager, Z.; Zabransky, B.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

New results on the transmission of fast molecular ions through thin foils are presented and a mechanism for the transmission process is proposed. The main feature of the postulated mechanism is that a finite fraction of the incident molecular beam does not undergo a strong Coulomb explosion while traversing the foil. Because the emerging fragments are at large internuclear separations, there is an enhanced probability for the formation of bound, long-range, excited electronic states following electron capture at the rear surface of the target.

55662 (CONF-790861—5) **Atomic processes pertinent to radiation physics.** Inokuti, M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From 11. international conference on the physics of electronic and atomic collisions; Kyoto, Japan (29 Aug 1979).

The physics of electronic and atomic collisions is a key element in the understanding of action of ionizing radiation on matter. Studies on radiation action in turn are fundamental to various aspects of the nuclear fission and fusion energy technology, most notably its health aspect. The lecture illustrates through selected

examples the use of electron-collision cross-section data in radiation physics. The cross-section data for this use must be absolute and comprehensive (i.e., referring to all major final states of a target atom or molecule and covering a wide range of independent variables such as incident energy). For the determination of a comprehensive and trustworthy set of electron-collision cross-section data for a given atom or molecule, various theoretical constraints prove to be useful. Various outstanding problems, both experimental and theoretical, are suggested for work in the near future.

55663 Negative ion formation by charge exchange between hydrogen and cesium. Hiskes, J.R.; Karo, A.M.; Willmann, P.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Stevens, W.J. (National Bureau of Standards, Washington, DC (USA)). *Phys. Lett., A;* **68**: No. 2, 221-222(2 Oct 1978).

The close coupled equations provide low-energy cross sections which are in good agreement with the experimental values.

55664 Double resonance and energy transfer in sulfur hexafluoride. Steinfeld, J.I.; Jensen, C.C. (Massachusetts Inst. of Tech., Cambridge). pp 190-192 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Preliminary results are presented of measurements of infrared double resonance at CO_2 laser frequencies in SF_6. (GHT)

55665 Laser-induced collisions. Harris, S.E.; Falcone, R.W.; Green, W.R.; Lidow, D.B.; White, J.C.; Young, J.F. (Stanford Univ., CA). pp 193-206 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Processes where one or more photons are utilized to conserve energy between the initial and final states of colliding atoms are described. Energy transfer is thus initiated, and directed to particular states, by the optical radiation. New experiments are reported which demonstrate a laser-induced collision.

55666 Optical coherent transients by laser frequency-switching. Brewer, R.G.; Genack, A.Z. (IBM Research Lab., San Jose, CA). pp 218-223 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Coherence phenomena such as photon echoes, free induction and nutation effects are easily detected in molecular iodine using a frequency-switched tunable cw dye laser. This technique is generally applicable to atoms, molecules, and solids and offers unique ways for probing dynamic interactions in a selective manner. Elastic and inelastic collision mechanisms for I_2 are examined independently and compared with theory.

55667 Resonance Raman spectroscopy: application of tunable lasers to the study of the molecular mechanisms and dynamics of visual excitation. Mathies, R.; Oseroff, A.R.; Freedman, T.B.; Stryer, L. (Yale Univ., New Haven, CT). pp 294-302 of Tunable lasers and applications. Mooradian, A.; Jaeger, T.; Stokseth, P. (eds.). New York, NY; Springer-Verlag (1976).

From Conference on tunable lasers and applications; Nordfjord, Norway (Jun 1976).

Molecular properties of rhodopsin were studied using resonance Raman spectroscopy to determine the mechanism of conformational changes in the chromophore during visual excitation. A technique was used for obtaining the resonance Raman spectrum of a photolabile molecule before it is altered by light. The essence of this approach is that the sample is rapidly flowed through the light beam so that the fraction of isomerized molecules in the illuminated volume is very small. A theory is presented for this rapid-flow technique, as are the resonance Raman spectra of unphotolyzed rhodopsin and of the protonated Schiff bases of all-trans, 9-cis, 11-cis, and 13-cis retinal. (GHT)

GENERAL FLUID DYNAMICS

55668 (UCRL—52609) **User's manual for PELE-IC: a computer code for Eulerian hydrodynamics.** McMaster, W.H.; Gong, E.Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 May 1979. Contract W-7405-ENG-48. 76p. Dep. NTIS, PC A05/MF A01.

The PELE-IC code is a two-dimensional semi-implicit Eulerian hydrodynamics computer program for the solution of incompressible flow coupled to flexible structures. The fluid, structure, and coupling algorithms have been verified by the calculation of solved problems from the literature and from air and steam blowdown experiments. The code is written in both plane and cylindrical coordinates using the following set of units: pressure in bars, distance in cm, and time in ms. The coupling algorithm is general enough to handle a wide variety of structural shapes. This user's manual gives a detailed explanation of the algorithms to help potential users to understand the capabilities and limitation of the code.

SUPERFLUIDITY

REFER ALSO TO CITATION(S) 55761

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

WEAK INTERACTIONS

55669 (LBL—9502) **Results from the Mark II dectetor at SPEAR: SLAC-LBL Mark II collaboration.** Abrams, G.S.; Alam, M.S.; Blocker, C.A. (Stanford Linear Accelerator Center, CA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 22p. (CONF-790642—4). Dep. NTIS, PC A02/MF A01.

From International conference on high energy physics; Geneva, Switzerland (27 Jun 1979).

Some recent results are presented from the Mark II detector at SPEAR: observation of some new D meson decay modes, including the Cabibbo suppressed K^-K^+ and $\pi^-\pi^+$ modes, measurements of the rho ν and $\pi\nu$ decays of the tau, and some new data on psi decays. 17 references.

55670 (SLAC—216) **Production of neutrinos and neutrino-like particles in proton-nucleus interactions.** Dishaw, J.P. (Stanford Linear Accelerator Center, CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 161p. Dep. NTIS, PC A08/MF A01.

Thesis.

An experimental search was performed to look for the direct production of neutrinos or neutrino-like particles, i.e., neutral particles which interact weakly with hadrons, in proton-nucleus interactions at 400 GeV incident proton energy. Possible sources of such particles include the semi-leptonic decay of new heavy particles such as charm, and the direct production of a light neutral Higgs particle such as the axion. The production of these particles has been inferred in this experiment by energy nonconservation in the collision of a proton with an iron nucleus. The total visible energy of the interaction was measured using a sampling ionization calorimeter. After correcting for beam intensity effects and cutting the data to eliminate systematic effects in the measurement, the final resolution of the calorimeter was 3.51% and increased with decreasing incident beam energy with a square root dependence on the beam energy. Energy nonconservation in the data is manifest as a non-Gaussian distribution on the low side of the calorimeter measured energy. Model calculations yield the fraction of events expected in this non-Gaussian behavior for the various sources of neutrinos or neutrino-like particles. A maximum likelihood fit to the data with the theoretical fraction of events expected yields the 95% confidence level production cross section upper limit values. The upper limits for general production of neutrino-like particles for various parameterizations of the production cross section are presented. The following specific upper limits have been established: charm particle production < 670 μbarns, supersymmetric particle production carrying an additional quantum number $R < 33$ μbarns (mass of 1 GeV), 8 μbarns (mass of 3 GeV); axion production $< 10^{-3}$ times the π^0 production cross section. 144 references.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 55670, 55693

55671 (LA—7903-PR, pp 35-36) **(p,π^+) reaction on hydrogen and deuterium.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

The reactions $p(p,\pi^+)d$ and $d(p,\pi^+)t$ were studied at 797 MeV. Typical pion spectra are shown. Structure in analyzing power angular distributions is noted. 2 figures. (RWR)

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 55669, 55693

55672 (LA—7903-PR, pp 52-54) **Measurement of the reaction $\pi d \rightarrow 2p$ from 80 MeV to 416 MeV.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Preliminary differential cross sections for five energies are shown as a function of cos² theta/sub c.m./ from 0.0 to 1.0. 1 figure, 1 table. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

55673 (INIS-mf—4634, pp 18-23) **Asymmetry analysis of target diagrams and mechanism for large transverse momenta.** Gaisser, T.K. (Delaware Univ., Newark (USA)); Sidhu, D.P. (Brookhaven National Lab., Upton, NY (USA)). Aug 1977.

From International cosmic ray conference; Plovdiv, Bulgaria (13 Aug 1977).

We describe a quantitative method for determining the amount of asymmetry present in target diagrams of secondaries from interactions of very high energy cosmic rays. Such asymmetries must appear if large transverse momenta reported in such experiments at approximately 10^5 GeV are due to hard scattering of constituents (partons, quarks) in the hadrons. This is currently the accepted explanation of high Psub(T) phenomena at accelerator energies.

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 55688

55674 (COO—3069-677, pp 155-178) **Pion production with real and virtual photons on nucleons in the resonance region.** Althoff, K.H. (Bonn Univ., Germany). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The discussion of pion production in the resonance region by real and virtual photons and electrons covers the first resonance region, higher resonances, the kinematics, electroproduction total cross sections, the threshold region, the Δ-1236 region, and the pion neutral dip. Diagrams of previous experiments are shown. 13 references. (JFP)

55675 (COO—3069-677, pp 179-211) **(γ,π⁺⁻) experiments to discrete nuclear states.** Bernstein, A.M. (Massachusetts Inst. of Technology, Cambridge). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

It is indicated how the (γ,π) reaction mechanism in complex nuclei can be tested by single arm experiments. In this connection a brief review is given of recent work performed to discrete final nuclear states and the direction of future research is noted. Recomendations for this future research are made. 31 references. (JFP)

55676 (UH—511-344-79) **Possible means of detecting the Higgs boson in e^+e^- annihilation.** Ma, E.; Okada, J. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Jun 1979. Contract EY-76-S-03-0511. 18p. Dep. NTIS, PC A02/MF A01.

The process $e^+e^- \rightarrow \mu^+\mu^- +$ anything is considered for the detection of the Higgs particle as a spike in the missing-mass plot. In an energy range near the Z mass, the signal is found to be reasonably large and the background to be relatively small, if the mass of the Higgs boson is less than about 20 GeV, and a large cut in the effective dimuon mass is applied. 5 references.

55677 (UH—511-352-79) **Photoproduction of Higgs bosons.** Ma, E. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Jul 1979. Contract EY-76-S-03-0511. 9p. Dep. NTIS, PC A02/MF A01.

The photoproduction of Higgs bosons is studied, and it is shown that it can have significant contributions from both the $\gamma \rightarrow \gamma H$ and the $G \rightarrow GH$ processes, where G is the color-octet gluon of quantum chromodynamics, if the number of heavy flavors is not too small. 11 references.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 55678, 55680

STRONG INTERACTIONS, GENERAL

55678 (UH—511-346-79) **Some properties of heavy quark systems.** Pakvasa, S. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Jun 1979. Contract EY-76-C-03-0511. 7p. Dep. NTIS, PC A02/MF A01.

Weak interaction mixing angles of heavy quarks in the standard model are constrained by considering K^0-anti K^0 system and $D^0 \rightarrow \pi^+\pi^-$ decay. The lifetimes, semileptonic and other branching ratios of mesons containing c, b, or t quarks and mass mixing and CP nonconservation in D and B systems are presented. Attempts to calculate m/sub t/ and the mixing angles are described. Finally, possible production and detection of t and heavier quarks in hadronic reactions is discussed.

55679 (UH—511-347-79) **Variation of mixing angles and masses with q^2 in the standard six-quark model.** Ma, E.; Pakvasa, S. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Jun 1979. Contract EY-76-S-03-0511. 12p. Dep. NTIS, PC A02/MF A01.

The variation of mixing angles and masses with q^2 in the standard six-quark model is given in terms of a set of coupled differential equations. It is shown that to lowest order, these equations do not depend on the SU(2) gauge coupling; and in the case of the mixing angles, not even on the U(1) gauge coupling. Experimental implications are briefly discussed. 17 references.

55680 (UH—511-353-79) **Fourth generation of quarks and leptons.** Pakvasa, S.; Sugawara, H.; Tuan, S.F. (Hawaii Univ., Honolulu (USA). Dept. of Physics). Jul 1979. Contract EY-76-S-03-0511. 5p. Dep. NTIS, PC A02/MF A01.

Permutation symmetry suggests an intergeneration quark-lepton mass formula m/sub μ/m/sub tau//m/sub L/ = m/sub s// m/sub b//m/sub b'/ = m/sub c//m/sub t//m/sub t'/. Several possibilities are considered for the fourth generation masses. 11 references.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 55676, 55678, 55691, 55742

55681 (UH—511-341-79) **Two-body hadronic decays of D-mesons.** Barger, V.; Pakvasa, S. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy; Wisconsin Univ., Madison (USA). Dept. of Physics). May 1979. Contract EY-76-S-03-0511. 13p. Dep. NTIS, PC A02/MF A01.

Account is given for the observed enhancement of $\Gamma(D^0 \rightarrow K^-K^+)/\Gamma(D^0 \rightarrow K^-\pi^+)$ and suppression of $\Gamma(D^0 \rightarrow \pi^-\pi^+)/\Gamma(D^0 \rightarrow K^-\pi^+)$ relative to tan $^2\theta$/sub C/ in terms of the ratio f/sub K//f/ sub π/ of leptonic decay constants and different effective Cabibbo angles in noncharm and charm sectors. Strong new constraints on mixing angles in the six-quark model are implied. 18 references.

55682 (UH—511-342-79) **Mass mixing and CP nonconservation in neutral B-meson systems.** Barger, V.; Long, W.F.; Pakvasa, S. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy; Wisconsin Univ., Madison (USA). Dept. of Physics). Jun 1979. Contract EY-76-S-03-0511. 14p. Dep. NTIS, PC A02/MF A01.

The complex mass and decay matrix parameters δm, δΓ, Γ, Im m_{12}, and Im Γ_{12} for B^0-anti B^0 mixing in the sequential six-quark model are calculated.

55683 (UH—511-343-79) **Numerical upper bounds on the CP nonconservation of neutral heavy meson systems in the standard six-quark model.** Ma, E.; Simmons, W.A.; Tuan, S.F. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). May 1979. Contract EY-76-S-03-0511. 17p. Dep. NTIS, PC A02/MF A01.

Using recently obtained bounds on the mixing angles in the standard six-quark model, and calculations of $Im\Gamma_{12}/Re\Gamma_{12}$ as well as the standard expressions of ImM_{12}/ReM_{12} for the heavy meson systems D^0-anti D^0, B^0-anti B^0, and B/sub s/°-anti B/sub s/°, upper limits of 4×10^{-3}, 5×10^{-4}, and 7×10^{-4} are found for the magnitude of the phase-convention-independent quantity 2 Reε/(1 + vertical bar ε vertical bar²), as a measure of the size of CP nonconservation in these respective systems. 17 references.

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 55675

55684 **Effect of hyperon channels in low-energy k^-d scattering.** Schick, L.H. (Wyoming Univ., Laramie (USA). Dept. of Physics and Astronomy); Gibson, B.F. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Z. Phys., A;* **288**: No. 3, 307-312(Nov 1978).

Within the framework of a Faddeev formalism and an implicit hyperon channel approximation, we have calculated K^-d elastic, total, and reaction cross sections for incident kaon laboratory momenta up to 120 Mev/c. We have used as input two different (slightly modified) multichannel M matrix fits to low-energy anti KN scattering, each of which contains explicitly the πY channels, as well as a single channel representation of the anti KN interaction in which the hyperon channels appear only through their contributions to the imaginary parts of the anti KN scattering lengths. The K^-d cross sections obtained with the single channel anti KN input differ by only some 10% from those for which we used the multichannel anti KN input. The K^-d cross sections calculated using anti KN

input parameters from each of the two separate M matrix fits differ across the entire momentum range investigated by 25-35%.

GENERAL

REFER ALSO TO CITATION(S) 55770

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 55419

55685 (BNL—50847) **Proceedings of the isotope separator on-line workshop.** Chrien, R.E. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Jul 1978. Contract EY-76-C-02-0016. 374p. (CONF-771078—). Dep. NTIS, PC A16/MF A01.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

Separate abstracts were prepared for thirteen of the papers in this volume. The remaining three have already been cited in ERA, and can be located by reference to the entry CONF-771078— in the Report Number Index. (RWR)

55686 (INIS-mf—4691) **Progress report on research and development in 1977.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1978. 375p. (In German). Dep. NTIS (US Sales Only), PC A16/MF A01.

Various sections of this report were processed individually for inclusion in the TIC data base as they were received on ATOMINDEX tapes. (RWR).

EXPERIMENTAL TECHNIQUES

55687 (COO—3069-677, pp 297-304) **Experimental problems in nucleon knockout reactions: triple coincidence experiments and a very large solid angle spectrometer.** Sargent, C.P. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The problems encountered in designing knockout reaction experiments are considered. The e,e'π^+p triple coincidence experiment is discussed as an example, and the preliminary considerations for the design of an electron spectrometer are set forth. 1 reference. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55748

55688 (COO—3069-677, pp 147-154) **Single nucleon operators in pion photoproduction from nuclei.** Dressler, E. (National Bureau of Standards, Washington, DC). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

A previous model, which is the sum of pseudovector Born diagrams plus the contribution from the S-channel delta-1236, is used to investigate the pion production mechanism for nucleons in a nucleus. For the two processes $H(\gamma,\pi^+)n$ and $H^2(\gamma,\pi^+)2n$ it is found that up to 60 MeV above threshold the Born part of a given operator dominates the cross section for both reactions, and the cancellation of the other terms occurs for the singlet and triplet terms individually. This surprising finding leads to the conjecture that approximating the production operator by the Born term should be valid for most nuclei even well above threshold, and a measurement of the pion angular distribution from deuterium would be a useful test of the studied Blomqvist - Laget model and the approximations used. 4 references. (JFP)

55689 (COO—3069-677, pp 229-238) **Nuclear physics experiments at DESY.** Roessle, E. (Fakultaet fuer Physik, Freiburg, West Germany). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

Previous published work on single arm experiments is considered. The discussion includes total cross sections for virtual photons in quasielastic scattering and production of the delta-3, 3 resonance in nuclei and shadowing of virtual photons in the deep inelastic region. 12 references. (JFP)

55690 (COO—3069-677, pp 239-249) **Coherent photo- and electroproduction of Δ's in nuclei.** Dillig, M.; Huber, M.G. (Univ. of Erlange-Nuernberg, West Germany). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

Some of the reasons for investigating nuclei by real or virtual photons at excitation energies between 200 and 400 MeV are pointed out; particular emphasis is put on the coherent photoproduction of pions where the final nucleus is left in a bound (ground or excited) state. The notion of collective A*-resonances (as opposed to the well known elementary A*-resonances) is exemplified for the deuteron and for ^{12}C in a OBEP-model. 17 references.

55691 (COO—3069-677, pp 250-258) **Charged pion electroproduction near threshold.** Donnelly, T.W. (Stanford Univ., Ca). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The reaction /sub z/A(e,e'π^+)/sub z -+ 1/ A is considered where the energy of the pion in the final state center-of-mass system is near threshold (typically within a few MeV of threshold). Since only nonresonant s-wave pion are necessary, there is the greatest chance of providing an adequate description of the process. The study is built on previous studies of the real photon reaction and for threshold pions there only the new aspects introduced when virtual photon are used are considered. Results are plotted for the reactions $^3He(e,e'\pi^+)^3H$ and $^6Li(e,e'\pi^+)^6He$ regarding the longitudinal and transverse response functions as functions of three-momentum transfer for pion electroproduction with final state center-of-mass pion energy 3.2 MeV. The real photon point is indicated. 9 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55671, 55675

55692 (CONF-790847—3) **LA-UR—79-2377.** Bowman, J.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

The pion single charge exchange program at LAMPF is reported. The LAMPF π^0 spectrometer is described and its successful performance in this first data run is discussed. Results on the excitation of the isobaric analog state (IAS) in pion single charge exchange at forward angles are presented. The IAS was observed for nuclei throughout the periodic table. The mass and energy dependence of the forward angle differential cross section is discussed. An angular distribution for the reaction $^3He(\pi^-,\pi^0)^3H$ at angles from 0 to 84° at a bombarding energy of 200 MeV is presented. The data indicate a substantial contribution from the spin-flip amplitude. Angular distributions for the $^{13}C(\pi^+,\pi^0)^{13}N(IAS)$ and $^7Li(\pi^+,\pi^0) \rightarrow {}^7Be(3/2^- + 1/2^-)$ reactions for angles from 0 to 45° at a bombarding energy of 150 MeV are presented. Partial angle integrated cross sections ($\theta < 45°$) are given. 15 references.

55693 **Particle-nuclei interactions in a streamer chamber: He results.** Allen, R.C.; Kanofsky, A.S.; Hasan, A. (Lehigh Univ., Bethlehem, PA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 652-653(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Results on particle—nuclei interactions in a He-filled streamer chamber are presented. 5 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

55694 (COO—3069-677, pp 368-371) **Electroexcitation of collective magnetic dipole resonances.** Knuepfer, W.; Huber, M.G. (Univ. Erlangen-Nuernberg, Germany). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

It is suggested measuring the distribution of the magnetic multipole transition strengths of various nuclei, particularly with inelastic electron scattering. The form factors for the M1 ($\Delta T = 1$) excitations in ^{12}C are shown as a function of the excitation energy for various fixed values of the momentum transfer. Also shown is a similar calculation for the M1 states in ^{28}Si and ^{40}Ca. All calculations were performed using a conventional effective residual interaction. It is found that the calculated distribution of the excitation strength depends sensitively on the strength constants of the spin- and spin-isospin-parts of this interaction. 11 references. (JFP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55690, 55691, 55694

55695 (LA—7903-PR, pp 36-39) **Quadrupole scattering of pions by ^{9}Be.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Angular distributions for π^{+-} + ^{9}Be elastic and inelastic scattering at 162 MeV are shown and analyzed. The inclusion of quadrupole contributions can account for the elastic scattering angular distributions. 2 figures. (RWR)

55696 **Simple potential model for the ^{12}C + ^{16}O resonances.** Golin, M.B. (Brookhaven National Lab., Upton, NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 508-509(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

The real part of the optical potential for ^{12}C + ^{16}O scattering is calculated in a microscopic double-folded model. The positions and spins of the known resonances are well reproduced by the calculation. A moderate, energy-dependent absorption proportional to the real part gives good agreement with the angular distribution data. 5 references.

55697 **Nucleon—nucleon forces and heavy-ion potentials.** Schultheis, H.; Schultheis, R. (Univ. of Maryland, College Park). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 512-513(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

The change in the heavy-ion interaction energy induced by neglecting the antisymmetrization between projectile and target was studied. The sign of the energy shift and its sensitivity to the strength, range and exchange terms of the nucleon—nucleon interaction were discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55700, 55704, 55706

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55675, 55692, 55712

55698 (LA—7903-PR, pp 45-47) **Development of pion beam monitoring techniques.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Cross sections for $^{12}C(\pi^{+-},\pi N)^{11}C$ reactions at 40 to 600 MeV are tabulated. 1 figure, 2 tables. (RWR)

55699 (LA—7903-PR, pp 47-48) **(p,d) reaction at 800 MeV.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Spectra for the reaction on ^{12}C and ^{28}Si are shown. Results of DWBA analysis of ^{12}C(p,d) and ^{40}Ca(p,d) reactions are also presented. 3 figures. (RWR)

55700 (LA—7932-MS) **Evaluated data for n + ^{9}Be reactions.** Young, P.G.; Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 66p. (ENDF—283). Dep. NTIS, PC A04/MF A01.

A new evaluation of neutron-induced reactions on ^{9}Be was completed for the energy range 10^{-5} eV to 20 MeV. Particular emphasis was placed on accurately representing new measurements of secondary neutron-emission spectra and scattering data between 6 and 15 MeV. Additionally, adjustments to the total, (n,γ), and (n,t) cross sections in previous ENDF/B evaluations were made, and covariance data files that contain error correlations for the cross sections and emission spectra were included in the evaluation. The data are available in ENDF/B format from the ENDF/A library at the National Nuclear Data Center at Brookhaven National Laboratory and from the Radiation Shielding Information Center at Oak Ridge National Laboratory. 90 references, 46 figures, 2 tables.

55701 **Elastic back angle scattering of ^{12}C.** Clover, M.R. (Rochester Univ., NY); DeVries, R.M.; Fulton, B.; Ost, R.; Rust, N.J.A.; Anantaraman, N.; Ford, J.L.C.; Shapira, D. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 598-599(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Ions from oxygen-16 to calcium-40 were used to bombard carbon 12 at 20 to 35 MeV. Oscillating angular distributions, excitation functions, and cross sections and their implications are discussed. 1 reference. (JFP)

55702 **Quasi-elastic scattering of 800 MeV protons and the detection of alpha particle and deuteron clusters in nuclei.** Chrien, R.E. (Brookhaven National Lab., Upton, NY); Kozlowski, T.; May, M. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 628-629(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

A survey of quasi-elastic scattering of 800 MeV protons was carried out at LAMPF using the high resolution spectrometer, and targets of ^{6}Li, Li, ^{12}C, ^{27}Al, ^{40}Ca, ^{51}V, ^{90}Zr and Pb. Measurements were made at angles of 5, 7, 9, 11, 13, 15, 25, and 30°. Absolute cross sections were obtained using known (p,p) elastic cross sections. The momentum spectra were taken from the elastic region to well beyond the quasielastic peak. The variation in peak cross section and the FWHM of the peaks with mass number is reported. Evidence is presented for the quasielastic scattering of protons from clusters of mass 4 in the nucleus. 2 references.

55703 **Emission of complex fragments in argon induced reactions at 213 MeV/A.** Viyogi, Y.P.; Beiser, F.; Crawford, H. (Lawrence Berkeley Lab., CA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 676-677(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

First results are reported from a study of reaction mechanisms in a ^{40}Ar beam of 10^{8} particles/s to bombard thorium and carbon targets. Results for energy spectra widths to be used to extract the temperature of the emitting system and those for the distribution of isotopes are being analyzed. 7 references. (JFP)

55704 **Contribution of alpha-cluster transfer processes in $^{12}C(^{9}Be,^{8}Be)^{13}C$ reactions.** Jarczyk, L. (Jagellonian Univ., Krakow, Poland); Kamys, B.; Strzalkowski, A.; Hugi, M.; Lang, J.; Mueller, R.; Ungricht, E. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 680-681(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Measurements of the reaction $^{12}C(^{9}Be,^{8}Be)^{13}C$ at 20 MeV indicate that neutron and ^{4}He-cluster transfer reactions have to be taken into account. 6 references.

55705 **Investigation of high spin states in 1p and 2sld shell nuclei via the (α,^{2}He) reaction.** Jahn, R.; Stahel, D.P.; Wozniak, G.J.; de Meijer, R.J.; Cerny, J. (Univ. of California, Berkeley). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 686-687(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

The (α,^{2}He) reaction was measured on 16 targets ranging from ^{12}C to ^{40}Ca in order to obtain an initial survey of this reaction. Large cross sections were found for transitions to states of (d/sub 5/2/)$_{h}^{2}$,(d/sub 3/2/f/sub 7/2/)$_{h}$, and (f/sub 7/2/)$_{h}^{2}$ character, resulting in the location of a number of 2n states, many of which were previously unknown. Spectra from the ^{28}Si, ^{26}Mg, and ^{29}Si targets bombarded by alpha particles in the reaction (α,^{2}He) and binding energies for several configurations as a function of the mass of the final nucleus are shown. 3 references. (JFP)

55706 **Measurement of alpha-widths in ^{16}O relevant to astrophysics.** Becchetti, F.D. (Univ. of Michigan, Ann Arbor); Janecke, J.; Overway, D.; Thorn, C.; Flynn, E.R.; Hanson, D.L.; Sunier, J.W.; Kekelis, G. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 752-753(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Several different α-transfer reactions, $^{12}C \rightarrow {}^{16}O$ were studied at high bombarding energies with magnetic spectrometers. Linewidths, α-spectroscopic factors, S/sub α/, and reduced α-widths, γ/sub α/^{2} and θ/sub α/^{2}, were determined for levels in ^{16}O, including several of importance in astrophysics. 8 references.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55694

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55694

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 55724

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55692, 55699, 55702, 55705, 55738

55707 (CONF-790847—4) **Isospin dependent terms in the N-N force at low q from (p,n) reactions.** Goodman, C.D.; Bainum, D.E.; Foster, C.C. (Oak Ridge National Lab., TN (USA); Emporia State Univ., KS (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

The $^{26}Mg(p,n)^{26}Al$ reaction to resolved final states is used to select out a spin-isospin component and an isospin component in the effective nucleon-nucleus interaction and to compare the strengths of these components at different energies. It is found that (V/sub sigma tau/ /V/sub tau/)^2 = 1.7 at 80 MeV and 4.6 at 120 MeV. 5 figures.

55708 Gamma-ray spectra in coincidence with protons from 300-MeV/c pions on ^{27}Al at LAMPF. McAdams, R.E. (Utah State Univ., Logan); Goulding, C.A.; Plendl, H.S. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 640-641(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Gamma-ray spectra were recently obtained in coincidence with particles from 300-MeV/c pions on ^{27}Al at LAMPF. The spectra of gamma rays in coincidence with the protons are presented along with the relative cross sections corresponding to the removal of particles equivalent to ^{6}Li, α, t, and d particles as well as for single-nucleon removal.

55709 Gamma-ray spectra in coincidence with scattered pions for 300-MeV/c pions on ^{27}Al at LAMPF. McAdams, R.E. (Utah State Univ., Logan); Goulding, C.A.; Plendl, H.S. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 642-643(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Gamma-ray spectra were recently obtained in coincidence with scattered particles for 300-MeV/c pions on ^{27}Al at LAMPF. Spectra are presented for gamma-rays in coincidence with scattered pions. The relative cross sections for production of residual nuclei which correspond to the removal of an equivalent ^{6}Li, α, t and d particles and for single nucleon removal are also presented. 1 reference.

55710 Particle-nuclei interactions in a streamer chamber: Ne results. Kanofsky, A.S.; Allen, R.C.; Hasan, A. (Lehigh Univ., Bethlehem, PA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 654-655(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Results on particle—nuclei interactions in a Ne-filled streamer chamber are presented. 5 figures.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55694

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55694, 55750

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55713

55711 High-excitation region in ^{53,60}Ni studied through (^{16}O, ^{12}C), (^{6}Li,d), and (t,p) reactions. Hanson, D.L.; Stein, N.; Sunier, J.W.; Woods, C.W. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 726-727(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

To obtain additional information on the structure of states having four-particle or alpha cluster structure, the high excitation region in ^{58,60}Ni with 50 to 100 MeV resolution was studied through the reactions ^{54,56}Fe(^{16}O, ^{12}C) at 50 MeV, ^{54,56}Fe(^{6}Li,d) at 34 MeV and ^{58}Ni(t,p) at 20 MeV. The level structure, four-nucleon transfer spectra, and relative spectroscopic factors are discussed. 3 references. (JFP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55692, 55702, 55705, 55711

55712 (LA—7903-PR, pp 32-34) **Quasi-elastic scattering of π^{+-} from ^{40,44,48}Ca and ^{12}C.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Differential cross sections for π^+ and π^- as a function of energy loss are shown for the following conditions: 180 MeV, 60°; 291 MeV, 60°; 291 MeV, 120°. Results of Monte Carlo calculations are also shown. 3 figures, 1 table. (RWR)

55713 Systematic behavior of (^{6}Li,d) ground-state transitions in the 1f—2p shell. Hanson, D.L.; Stein, N.; Sunier, J.W.; Woods, C.W.; Betts, R.R. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 716-717(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

The (^{6}Li,d) reaction was studied at 34 MeV incident energy for final nuclei between ^{44}Ti and ^{64}Zn. The variation of S/sub α/ with Z and A of the final nuclei is shown. The present results contain significant differences compared with previously published work covering the f-p shell region. Two striking features that are new are the sharp increases of about 100% in spectroscopic strength that seem well correlated with the shell gaps at N = 28 and Z = 28. The previously derived spectroscopic factors also displayed the minimum near A = 54 and the increasing trend toward A = 64, but with no evidence of the sharp shell structure that can be seen. 3 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 55731

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55711, 55713

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55711, 55713, 55731

55714 (BNL—50847, pp 331-352) **Recent developments and results with the GSI on-line separator at the UNILAC.** Roeckl, E.; Kirchner, R.; Klepper, O.; Nyman, G.; Reisdorf, W. (GSI Darmstadt, Germany). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The GSI mass separator facility on-line to the heavy-ion accelerator UNILAC was applied for separation of neutron-deficient isotopes from ^{40}Ar- and ^{58}Ni-induced fusion reactions. A status report on the facility is given with particular emphasis on separation parameters such as overall efficiency and release time for isotopes in the tin region (46 ≦ Z ≦ 55). Examples for current experiments are the measurement of isotopic distributions of evaporation residues in comparison with predictions from evaporation calculations, and production of very neutron-deficient isotopes of tellurium, iodine, and xenon via ^{58}Ni-induced reactions on ^{58}Ni and ^{63}Cu targets. The new isotopes identified in this region, including the island of the α emitters ^{108}Te, ^{109}Te, ^{110}I, and ^{111}I, are discussed within the framework of mass β-strength-function systematics, in view of extending the search for neutron-deficient isotopes at the proton drip line. 11 figures.

55715 (LA—7903-PR, pp 56-57) **Measurements of cross sections for proton-induced formation of spallation products in copper by activation analysis.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Cross sections for 800-MeV bombardment are tabulated for the following product nuclei: ^{65}Zn, ^{65}Ni, ^{64}Cu, ^{63}Zn, ^{62}Zn, ^{62}Cu, / sup 62m/Co, and ^{61}Cu. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

55716 (BNL—50847, pp 205-236) **Realistic nuclear shell theory and the doubly-magic ^{132}Sn region.** Vary, J.P. Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

After an introduction discussing the motivation and interest in results obtained with isotope separators, the fundamental problem in realistic nuclear shell theory is posed in the context of renormalization theory. Then some of the important developments that have occurred over the last fifteen years in the derivation of the effective Hamiltonian and application of realistic nuclear shell theory are briefly reviewed. Doubly magic regions of the periodic table and the unique advantages of the ^{132}Sn region are described. Then results are shown for the ground-state properties of ^{132}Sn as calculated from the density-dependent Hartree-Fock approach with the Skyrme Hamiltonian. A single theoretical Hamiltonian for all nuclei from doubly magic ^{132}Sn to doubly magic ^{208}Pb is presented; single-particle energies are graphed. Finally, predictions of shell-model level-density distributions obtained with spectral distribution methods are discussed; calculated level densities are shown for ^{136}Xe. 10 figures. (RWR)

55717 (BNL—50847, pp 263-288) **Collective structure of medium-mass nuclei.** Williams, S.A. (Iowa State Univ., Ames). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The level structure and electromagnetic transitions for the even-even Pd and Cd isotopes were investigated. A modified Davydov-Chaban model was found to be successful in reproducing experimental data; theory and experiment are compared for ^{102}Pd through ^{114}Pd and ^{106}Cd, ^{112}Cd, ^{116}Cd, and ^{122}Cd. BE(2) ratios for some Pd and Cd isotopes are tabulated. It was found necessary to assume the existence of an additional degree of freedom in the model; this turned out to be extra-core particles moving as zero-coupled pairs, sometimes referred to as pairing vibrations. Results of zero-coupled pair calculations for the Pd isotopes are given, as are results of applying the quadratic potential model to ^{106}Pd. 20 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55750

55718 (COO—3069-677) **Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.** Bernstein, A.M. (ed.). (Massachusetts Inst. of Tech., Cambridge (USA)). 1977. Contract EY-76-C-02-3069. 417p. Dep. NTIS, PC A18/MF A01.

Separate abstracts were prepared for the 22 papers presented. (JFP)

55719 (COO—3069-677, pp 341-354) **High multipolarity elastic magnetic electron scattering.** DeVries, H.; DeWitt-Huberts, P.; Dieperink, A.E.L.; Donnelly, T.W. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

Elastic magnetic electron scattering calculations were performed for ^{93}Nb and ^{87}Sr. A comparison is made between proton and neutron radial distributions for a given shell obtained by measurements on odd-proton and odd-neutron nuclei as above in the same region of the periodic table. The experimental data are from previous work in the presented plots of the electron elastic magnetic scattering for strontium 87 as functions of momentum transfer. 5 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 55731

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 55714, 55725, 55727

55720 (BNL—50847, pp 87-107) **Current research on delayed neutron emission at the SOLAR facility.** Reeder, P.L. (Battelle-Pacific Northwest Labs., Richland, WA). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The SOLAR (Spectrometer for On-Line Analysis of Radionuclides) facility is an on-line mass spectrometer operated at a 1-MW TRIGA reactor at Washington State University. The facility is described, and then typical results in gamma and neutron spectroscopy studies are presented. Delayed neutron emission probability is tabulated for $^{93\ 94\ 95\ 96\ 97}$Rb and $^{143\ 144\ 145}$Cs, along with percentage neutron emission to excited states. Energy-level diagrams are shown for ^{145}Ba and ^{95}Sr. Delayed neutron spectra are presented for $^{93\ 94\ 95\ 96}$Rb, as well as low-energy neutron spectra for ^{93}Rb and ^{94}Rb. Determination of the efficiency of a ^{3}He ionization chamber neutron spectrometer is discussed, and the efficiency curve obtained is shown. 16 figures, 6 tables. (RWR)

55721 (BNL—50847, pp 109-148) **Applications of fission-product decay data.** Reich, C.W. (Idaho National Engineering Lab., Idaho Falls). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The relevance of fission-product decay data to a number of currently important activities is discussed. Specific reactor-related areas treated include fission-product decay heat, monitoring of nuclear power plants, fast-reactor dosimetry, and the measurement of fission-product cross sections using activation techniques. The organization and content of the decay data included in the Evaluated Nuclear Data File (ENDF/B), an important user-oriented data evaluation, is given. A discussion of β-strength function measurements on short-lived fission products is presented, and a possible application of data from these studies to the decay-heat problem is pointed out. 4 figures, 7 tables.

55722 (BNL—50847, pp 169-204) **Recent results from studies of non-gaseous fission products with TRISTAN II.** Hill, J.C. (Iowa State Univ., Ames). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

A new in-beam target ion-source combination was installed at the TRISTAN isotope separator facility. Mass-separated beams of non-gaseous fission products are now available for study. Studies of levels in even-even Cd and Sn nuclei populated through the decay of Ag and In fission products are described, and an evaluation of possibilities for future research is made. 25 figures.

55723 (BNL—50847, pp 247-262) **Study of neutron-rich Rb and Cs isotopes at OSTIS.** Wuensch, K.D.; Wollnik, H. (Univ., Giessen, Germany). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

An on-line mass separator for thermally ionized fission products (OSTIS) was installed at a neutron guide tube of the High Flux Reactor of the Institute Laue-Langevin in Grenoble. This apparatus provides pure Rb and Cs isotope beams with intensities of up to a few x 10^6 atoms per second focused on an area of less than 5 mm diameter. The contamination by neighboring masses or by other elements is lower than 10^{-5}. Several arrangements are used for beta, gamma, and delayed-neutron spectroscopy as well as for the measurements of yields and half-lives. Some of the results are discussed. 10 figures, 1 table.

55724 (BNL—50847, pp 309-330) **Some recent experiments at ISOLDE.** Hardy, J.C. (Chalk River Nuclear Labs., Ontario). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The Chalk River ISOL and ISOLDE are briefly described. Experiments detecting β-delayed protons from the decay of the T/ sub z/ = -2 nucleus ^{33}Ar and measuring the lifetimes of particle-unstable states in light electron-capture nuclei are sketched. Finally, a fictional nucleus (called pandemonium) was created, and its decay was simulated numerically by use of statistical principles. β-transition rates were known exactly, and an analysis of a simulated spectrum of β-delayed γ rays could be made. Transition rates could then be extracted from the simulated numerical data and compared with the known true rates. 14% of the γ intensity above 1.7 MeV was undetected in a peak analysis, and only about 35 out of 1000 gamma rays were identified. If the number of counts had been a factor of 10 less, 45% of the intensity would have been lost. Thus, every complex β-decay scheme that is based on γ-ray peak analysis and intensity balances must now be regarded as doubtful. If significant γ-ray intensity remains unobserved, the derived β-decay branching ratios could be wrong by orders of magnitude. 12 figures.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 54860, 55720, 55722, 55730, 55732, 55733

55725 (BNL—50847, pp 67-86) **Studies of fission fragments using the gas-filled recoil separator JOSEF.** Khan, T.A.; Lauppe, W.D.; Sistemich, K. (Institut fuer Kernphysik, Juelich, Germany). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

The JOSEF mass separator is briefly described first. Then the structure of the first excited 0^+ state in ^{100}Zr is discussed at some length. γ and Ce spectra were measured, and an energy-level diagram is presented for ^{100}Zr. Research on ^{132}Sn is described briefly, and an energy-level diagram for this nucleus is shown. 11 figures. (RWR)

55726 (BNL—50847, pp 353-362) **Fast ion beam spectroscopy at the Marburg separator.** Hoehle, C.; Huehnermann, H.; Kroemer, G.; Meier, T.; Wagner, H.; Walcher, W. (Philipps Univ., Marburg, Germany). Jul 1978.

From Workshop on ISOL systems; Upton, NY, USA (31 Oct 1977).

Fast ion beam spectroscopy of Xe and Ba was performed at the Marburg off-line separator to determine the optical hyperfine structure and the isotope shift by means of a tunable laser. A reduction of the Doppler broadening of the spectral lines according to the calculations of Kaufman was observed. The error limits for the hyperfine splitting factors A and B and for the isotope shifts were on the order of 0.05 mK ($\sim$ 1.5 MHz). On-line measurements on Ba seem possible for an ion current of 10^5 ions/s with 100 counts per second at the detector in resonance. 8 figures, 2 tables.

55727 (UCRL—52825) **Nuclear structure of tellurium 133 via beta decay and shell model calculations in the doubly magic tin 132 region.** Lane, S.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 261p. Dep. NTIS, PC A12/MF A01.

Thesis.

An experimental investigation of the level structure of ^{133}Te was performed by spectroscopy of gamma-rays following the beta-decay of 2.7 min ^{133}Sb. Multiscaled gamma-ray singles spectra and 2.5 x 10^7 gamma-gamma coincidence events were used in the assignment of 105 of the approximately 400 observed gamma-rays to ^{133}Sb decay and in the construction of the ^{133}Te level scheme with 29 excited levels. One hundred twenty-two gamma-rays were identified as originating in the decay of other isotopes of Sb or their daughter products. The remaining gamma-rays were associated with the decay of impurity atoms or have as yet not been identified. A new computer program based on the Lanczos tridiagonalization algorithm using an uncoupled m-scheme basis and vector manipulations was written. It was used to calculate energy levels, parities, spins, model wavefunctions, neutron and proton separation energies, and some electromagnetic transition probabilities for the following nuclei in the ^{132}Sn region: ^{128}Sn, ^{129}Sn, ^{130}Sn, ^{131}Sn, ^{130}Sb, ^{131}Sb, ^{132}Sb, ^{133}Sb, ^{132}Te, ^{133}Te, ^{134}Te, ^{134}I, ^{135}I, ^{135}Xe, and ^{136}Xe. The results are compared with experiment and the agreement is generally good. For non-magic nuclei: the lg/sub 7/2/, 2d/sub 5/2/, 2d/sub 3/2/, 1h/sub 11/2/, and 3s/sub 1/2/ orbitals are available to valence protons and the 2d/sub 5/2/, 2d/sub 3/2/, 1h/sub 11/2/, and 3s/sub 1/2/ orbitals are available to valence neutron holes. The present CDC7600 computer code can accommodate 59 single particle states and vectors comprised of 30,000 Slater determinants. The effective interaction used was that of Petrovich, McManus, and Madsen, a modification of the Kallio-Kolltveit realistic force. Single particle energies, effective charges and effective g-factors were determined from experimental data for nuclei in the ^{132}Sn region. 116 references.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55692, 55702, 55718

55728 (COO—3069-677, pp 11-45) **Electromagnetic coincidence experiments.** O'Connell, J.S. (National Bureau of Standards, Washington, DC); Schoch, B. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

Three classes of coincidence measurements are discussed: electron scattering, tagged bremsstrahlung (e,e'γ) where e' and x are detected, and correlated products (γ,xy) where the γ's are from bremsstrahlung. The nuclear physics motivation for doing coincidence measurements is discussed. Some common features of the reactions are mentioned as are factors affecting count rate limitations. Mainly considered is the presentation of a variety of examples from previous work. Sometimes counting rates from typical experimental arrangements are estimated. The aim is to provide a rough classification of types of measurements into feasibility classes. 23 references. (JFP)

55729 (COO—3069-677, pp 212-228) **High energy photonuclear reactions and isobar-nuclear dynamics.** Moniz, E.J. (Massachusetts Inst. of Technology, Cambridge). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The higher energy region in which photon - nucleon interactions are dominated by Δ excitation (i.e., approximately 300 MeV photon energy) is discussed. Photoreactions are emphasized, and electron scattering (virtual photon induced reactions) are also considered. Isobar - nucleus physics is described. 10 references. (JFP)

55730 (COO—3069-677, pp 317-324) **Nuclear electron scattering.** Negele, J.W. (Massachusetts Inst. of Technology, Cambridge). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The status of theoretical efforts to evaluate electromagnetic charge, magnetization and current densities in finite nuclei is briefly surveyed. Selected elastic Coulomb and magnetic electron scattering results, inelastic scattering data, and coincidence experiments are discussed and shown to raise significant questions well beyond the level of existing theory. 75 references.

55731 (LA—7903-PR, pp 39-45) **Elastic and inelastic π^{+-} scattering from ^{89}Y, ^{92}Mo, and ^{116}Sn.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

Angular distributions near 180 MeV bombarding energy are shown, and a preliminary DWBA analysis is made. Problems in extracting radius parameters are discussed, and deformation parameters are tabulated. 8 figures, 2 tables. (RWR)

55732 **Alpha-cluster pickup reactions on even Sn and Te nuclei.** Jaenecke, J. (Univ. of Michigan, Ann Arbor); Becchetti, F.D. Jr.; Thorn, C.E. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 714-715(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Spectra for Te(d,^{6}Li)Sn and Sn(d,^{6}Li)Cd were obtained for an energy of 33 MeV. Complete angular distributions were measured for ^{122}Te(d,^{6}Li)^{118}Sn and are shown as well as the energy spectra. 11 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55438

55733 (LBL—9570) **Some perspectives on high-spin physics.** Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 22p. (CONF-790323—6). Dep. NTIS, PC A02/MF A01.

From Symposium on high spin phenomena in nuclei; Argonne, IL, USA (15 Mar 1979).

This report consists of a talk presented at the conclusion of a meeting. As is typical, this talk does not truly summarize what was said at the meeting; the author acknowledges that he discusses several areas of interest to him - some of which were covered at the meeting and some of which were not. High-spin phenomena are divided into collective and noncollective regions, each of which exhibits resolved and unresolved γ rays. Rotational spectra in the unresolved collective region are discussed; correlations between γ-ray energy and spin and between γ-ray energies in a rotational nucleus are pointed out. In the resolved noncollective region, the spectrum of ^{152}Dy exhibits a straight line when energy is plotted vs I(I+1); it is concluded that shell effects explain this behavior. In summary, the author in his talk has tried to indicate areas of current research interest. 10 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55714

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55735, 55741

55734 (COO—3069-677, pp 355-362A) **Transition density of the octupole vibration in ^{208}Pb. Comparison of theory and experiment.** Frois, B. (Centre d'Etudes Nucleaires, de Saclay, France); Heisenberg, J. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The transition charge density for lead 208 was calculated using random phase approximation calculations and is shown. It has a large peak centered at the nuclear surface at abour r = 7fm and pronounced oscillations in the interior of the nucleus for 0 ≦ r ≦ 5 fm. With the hydrodynamic or the Tassie model the transition density can be related to the ground state charge density. It is noted that the fluctuations in the ground state charge density are not at all large enough to explain the observed oscillations. The structure of this transition strength is described. A comparison is given of experimental data for σ/σ/sub Mott/ to theoretical predictions for the 3^- state in ^{208}Pb. 14 references. (JFP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55741

55735 (COO—3069-677, pp 363-367) **Electroexcitations of high spin states.** Knuepfer, W.; Huber, M.G. (Univ. Erlange-Nuernberg, Germany). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

It is pointed out that some nuclear excitations of low lying high spin states and their related phenomena can best be studied by inelastic scattering of high energy electrons. Previous work done on lead 208 is given as an example. The measured 2^+ and 4^+ form factors at 4.09 and 4.32 respectively are compared with calculated results, and their implications considered. The prospects for using (e,e') scattering to study other nuclei are also briefly considered. 7 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 55438

55736 **Level structure of ^{192}Os and the IBA model.** Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)); Boerner, H.G.; Pinston, J.A.; Davidson, W.F. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). *Nucl. Phys., A;* **309**: No. 1, 206-220(1978).

Gamma-ray transitions in ^{192}Os have been studied following twofold neutron capture on ^{190}Os. Precise γ-ray energies have been obtained with the use of bent crystal spectrometers. The thermal capture cross section on the ^{191}Os ground state (T/sub 1/2/ = 15d) has been determined to be 383 +- 54 b. A level scheme has been constructed. With the use of branching ratio and population systematics arguments these levels are assigned to various rotational bands whose character is discussed in terms of the transition occurring in the region between the O(6) limit of the interacting boson approximation model and the symmetric rotor.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55692, 55736

55737 (LA—7903-PR, pp 57-58) **Large-angle proton scattering from ^{40}Ca and ^{208}Pb at 800 MeV.** Jul 1979.

In Medium-energy physics program. Progress report, August 1-October 31, 1978.

A preliminary angular distribution for proton elastic scattering by ^{208}Pb at 800 MeV is shown out to 44° (c.m.). 1 figure. (RWR)

55738 **Fragment emission from nuclei at higher energies.** Hendrie, D.L. (California Univ., Berkeley). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 402-414(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

A summary is given of individual experiments on heavy-ion fragmentation. Also a summary of all results is shown on a temperature scale. It is noted that these data include no evidence for cluster effects and hardly any dependence on nuclear structure except for Q value effects. 21 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55703

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 55651

55739 (ORNL/TM—6805) **Interim report on the ORNL absolute measureoffoments of anti ν/sub p/ for ^{252}Cf.** Spencer, R.R.; Gwin, R.; Ingle, R.; Weaver, H. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 86p. Dep. NTIS, PC A05/MF A01.

An initial effort was made to measure absolutely the average number of prompt neutrons, anti ν/sub p/, emitted in spontaneous fission of ^{252}Cf to an unprecedented accuracy of +- 0.25%. Fission neutrons were counted with a large, gadolinium poisoned, liquid scintillator. A white source of neutrons from the ORELA was used to calibrate the detector efficiency as a function of neutron energy. Source neutrons were scattered into the large scintillator by a thin NE-213 proton-recoil detector which employed pulse shape discrimination to eliminate unwanted γ-ray background. The resulting neutron-energy and scattering angle-dependent efficiencies were used to normalize a Monte Carlo calculation of the scintillator efficiency for fission neutrons. Under the assumptions that the effects of parasitic charged particle reactions and multiple neutron scattering in the proton-recoil counter have negligible influence on the efficiency calibration, the value of the average number of prompt neutrons emitted per ^{252}Cf fission was found to be 3.783 +- 0.010. This report is intended as a documentary and guide for future measurements incorporating improvements suggested by the analysis of this first determination. 31 references.

NUCLEAR THEORY

55740 (LA—7852-C) **Los Alamos Scientific Laboratory Summer School on Nuclear Science.** Cooper, M.; Redwine, R.; Mischke, R. (eds.). (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 273p. (CONF-7806154—). Dep. NTIS, PC A12/MF A01.

From Los Alamos Scientific Laboratory summer school on nuclear science; Los Alamos, NM, USA (Jun 1978).

Separate abstracts were prepared for the three lectures presented. (JFP)

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 55747, 55749, 55751

55741 (COO—3069-677, pp 372-392) **Electromagnetic form factors of odd-even deformed nuclei.** de Guerra, E.M. (Massachusetts Inst. of Technology, Cambridge); Dieperink, A.E.L. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

Some aspects of transverse electron scattering on odd-even nuclei are discussed in terms of various models, mainly the Nilsson and Hartree-Fock models. The calculated electromagnetic form factors in the projected Hartree-Fock approximation, some numerical predictions for the simple Nilsson scheme, and problems related to a possible violation of current conservation are discussed. 5 references. (JFP)

55742 (LA—7852-C, pp 1-126) **Mesonic effects in nuclear physics.** Johnson, M. (Los Alamos Scientific Lab., NM). Jun 1978.

From Los Alamos Scientific Laboratory summer school on nuclear science; Los Alamos, NM, USA (Jun 1978).

The relation between mesons and nucleons and the properties of nuclear matter, as presently understood, is considered in these lectures. Feynman diagrams, meson theoretical nucleon-nucleon interactions, mesonic components in nuclear wave functions, direct observation of mesonic components in NN scattering above the pion production threshold, nuclear matter theory, and pion condensation are treated. 120 references. (JFP)

55743 (LA—7852-C, pp 127-187) **Application of nuclear physics to other scientific fields.** Tombrello, T.A. (California Inst. of Tech., Pasadena). Jun 1978.

From Los Alamos Scientific Laboratory summer school on nuclear science; Los Alamos, NM, USA (Jun 1978).

Knowledge of the structure of nuclei, their systematic properties, and the mechanisms by which they interact provides a powerful

tool that may be applied to understanding a variety of phenomena. In these five lectures a few specific examples are given that have arisen in the fields of astrophysics, planetary science, geophysics, and materials science. Although some of the nuclear physics involved was well known to Rutherford, it is found that it continues to generate new ideas for application. 74 references.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 55742, 55751

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 55697, 55718, 55741, 55743

55744 (COO—3069-677, pp 46-127) **Meson currents & few nucleon systems.** Hadjimichael, E. (Fairfield Univ., CT); Lomon, E.L.; Turchinetz, W. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The theoretical question of uniqueness and completeness of the results for meson exchange currents is discussed. A list of provisionally acceptable forms of mexonic-exchange contributions to the nuclear current is given. Proposed activities for future research are listed. 85 references. (JFP)

55745 (COO—3069-677, pp 128-146) **Photoproduction of pions at low energies.** Koch, J.H. (Masschusetts Inst. of Technology, Cambridge). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

Three physical aspects of pion photoproduction at low energies are discussed, namely, the production mechanism, the pion - nucleus interaction, and target structure. Some of the theoretical models are considered in more detail. 27 references. (JFP)

55746 (COO—3069-677, pp 259-268) **Knock-out reactions.** de Forest, T. Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam, Netherlands). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

It is pointed out that the primary motivation for performing high energy single nucleon knock-out reactions is based on the concept of quasi-elastic scattering. The validity of and corrections to the partial wave impulse approximation and kinematical invariance of knock-out reactions and tests of the reaction mechanism are treated. The effect of distortions on the momentum distribution in the effective momentum approximation for given parameters are plotted. 12 references. (JFP)

55747 (COO—3069-677, pp 305-317) **Electron scattering as a probe of nuclear structure.** Heisenberg, J.; Negele, J.W. 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The review of workshop topics on electron scattering as a nuclear structure probe includes elastic and inelastic scattering and deformed nuclei. (JFP)

55748 (COO—3069-677, pp 393-415) **What can one learn with polarized targets in (e,e').** Rawitscher, G. (Univ. of Connecticut, Storrs). 1977.

In Proceedings of the June workshop in intermediate energy electromagnetic interactions with nuclei, held at MIT, June 13-24, 1977.

The general properties of the formulae which were derived for electron inelastic scattering on polarized targets is reviewed. It is concluded that scattering from polarized targets as well as angular correlations of the inelastically scattered electrons with the radiation emitted during the de-excitation process will help to determine the various transition matrix elements which enter in the electron-nucleus interaction in a model independent way. In particular it is noted that the scattering of electrons from polarized deuterons at large momentum transfers should be very useful for separating the C2 from C0 amplitudes, thus clarifying the properties of the two-nucleon system and the role of exchange currents. 21 references. (JFP)

55749 (LA—7852-C, pp 227-258) **Giant multipole resonances from hadron and heavy-ion inelastic scattering.** Youngblood, D.H. (Texas A & M Univ., College Station). Jun 1978.

From Los Alamos Scientific Laboratory summer school on nuclear science; Los Alamos, NM, USA (Jun 1978).

Multipole resonances are described, and a brief description is given of the state of experimental knowledge (primarily of the quadrupole state) one to two years ago. Specific results are given on the quadrupole, and recent work on the low energy octupole resonance are discussed. Convincing evidence is given for the breathing mode state in several nuclei and the implications for the nuclear compressibility. Lastly existing evidence for excitation of these modes in heavy ion inelastic scattering is presented. 47 references. (JFP)

55750 (UCRL—83247) **Decay of deformed and superdeformed nuclei formed in heavy ion reactions.** Blann, M.; Komoto, T.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 59p. (CONF-790943—1). Dep. NTIS, PC A04/MF A01.

From 12. summer school in nuclear physics; Mikoajki, Poland (2 Sep 1979).

The importance of considering the deformation of nuclei at high angular momenta in computing transmission coefficients for their decay is examined. Deformations based on the rotating liquid drop model were used to generate transmission coefficients versus compound nucleus angular momentum. The results were then used in a Hauser-Feshbach code that included fission competition to assess the ultimate importance of deformation-modified transmission coefficients. It was found that for a broad range of prolate nuclei (superdeformed) the course of deexcitation predicted changes totally from predominant fission to predominant α decay due to a new mechanism called α decay amplification. The phase space relationships responsible for this new mechanism are presented. It is shown that this predicted new decay mode of superdeformed nuclei is consistent with a large body of existing experimental results, although more explicit experiments must be completed to confirm the new mechanism. 23 figures, 4 tables.

55751 **Nuclear fermidynamics and TD-S-HF.** Griffin, J.J. (Univ. of Maryland, College Park). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 114-131(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Four mainstream theoretical descriptions of nuclear matter flow are measured against six physical features of nuclei and nuclear heavy-ion collisions. Conventional (one single-determinantal wave function) time-dependent Hartree—Fock theory emerges favorably from the comparison, but fares poorly as a phenomenology. A completely restructured theory, the TD-S-HF, involving many single-determinantal wave functions is proposed by analogy with S-matrix reaction theory. It leads one to place the physical interpretation of the reactions upon time averages of asymptotic channel states of TDHF droplets, comprising the translations and periodic TDHF vibrations of isolated integer-nucleon subsystems. In its most naive form (based on small amplitude properties) the theory would consistently describe only the kinematic behavior of classical intrinsically dissipative TDHF droplets. But if the periodic solutions of TDHF were to occur only at isolated energies and amplitudes, then the theory would describe quantized TDHF droplets with (time-averaged) orthogonal channels, in which periodic solutions play the role of eigenstates in close analogy with the Schroedinger theory. 51 references.

55752 **Alpha clustering studied with the (^{6}Li,d) and (d,^{6}Li) reactions.** Becchetti, F.D. (Univ. of Michigan, Ann Arbor). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 47, 308-325(1978). (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

The systematics, throughout the periodic table, of the (^{6}Li,d) and (d,^{6}Li) reactions are reviewed. The α-spectroscopic factors extracted exhibit correlations with shell effects, nuclear pairing and nuclear deformation. The data are compared with calculations using SU3, pseudo-SU3, the jj-shell model, the pairing-vibration and boson-expansion models. Many, but not all of the experimental features are reproduced by existing models. 37 references.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 55716

55753 **Clustering aspects of nuclear structure and nuclear reactions.** Van Oers, W.T.H.; Svenne, J.P.; McKee, J.S.C.; Falk, W.R. (eds.). New York, NY; American Inst. of Physics (1978). 816p. (CONF-780644—).

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

The conference included 159 papers. Separate abstracts were prepared for 156 papers. Three papers appeared previously in ERA. (JFP)

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 55230, 55647, 55662

55754 (INIS-mf—4905, pp 103-110) **Fission fragment passage in a small-size single crystal.** Krasnoshtanov, V.F.; Maksimov, V.A. 1978. (In Russian).

From Conference on reactor materials science; Alushta, Ukrainian SSR (29 May 1978).

By use of the method of mathematical simulation, the passage of a 100 MeV fission fragment with mass 140 amu and charge 20 through an insulated solid hydrogen single crystal was investigated. The problem was reduced to the consideration of multiple scattering in a Coulomb field in terms of classical mechanics. It was found that for the time of the fragment flight through the microcrystallite 17% of the electrons left the latter. Among the remaining electrons only 40% of them had energy lower than 10 eV (the work function for the given microcrystallite). Thus, the concept of the "ion burst" is confirmed with a greater probability.

55755 (ORNL/TM—6954) **User's manual for PHOEL-2: a Monte Carlo computer code for calculating energies of photoelectrons and Compton electrons in water.** Turner, J.E.; Hamm, R.N.; Wright, H.A.; Modolo, J.T.; Sordi, G.M.A.A. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

A Monte Carlo computer code, PHOEL-2, is described for generating the energies of photoelectrons and Compton electrons in water irradiated uniformly by photons having an arbitrary energy spectrum. The code treats input photons individually on the basis of the energy-dependent cross sections for Compton scattering and for the photoelectric effect. Options exist for following each photon through successive Compton scattering events until it disappears by photoelectric absorption or allowing at most only a single Compton scattering event per input photon. The photoelectric effect can be turned on or off with either option. If energetically possible, the photoelectron is assumed to come from the oxygen K shell; otherwise, it originates in the L shell. An Auger electron of energy 0.508 keV is assumed to be emitted following the creation of a K vacancy. The basic numerical data used in PHOEL-2, their mathematical treatment, and the operation of the code are described. Detailed comparisons made with work for ^{60}Co, and monoenergetic x rays confirm the numerical validity of results obtained with the code. Some of the data of Cormack and Johns are extended by including successive Compton scatterings for the same photon and by including the photoelectric effect and Auger electrons. PHOEL-2 can be obtained from the Radiation Shielding Information Center at Oak Ridge National Laboratory. The new version differs from the old by employing a more realistic handling of the photoelectric cross section as a function of energy, compiling electron spectra instead of storing the energies of every electron produced, eliminating some former input restrictions, and using a different random number generator. PHOEL-2 does not treat pair production, which should be included for water at photon energies above about 2000 keV. 5 figures, 4 tables.

55756 (SAND—79-0486C) **Projectile size dependence of stopping power.** Brice, D.K. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 29p. (CONF-790843—2). Dep. NTIS, PC A03/MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

Recent measurements for 0-, 1-, and 2-electron ions channeled in [111] Au suggest that the electronic stopping power, dE/dx, depends on the spatial distribution of charge on the projectile. We have investigated the effect of the projectile charge distribution on dE/dx using the Lindhard dielectric theory of stopping. The charge distribution contribution is demonstrated directly within the framework of this theory. Good agreement is obtained between experiment and theory when higher order z_1-effects, which are of comparable magnitude ($\sim$ 5 to 10%), are included in a self-consistent phenomenological manner.

55757 (SAND—79-1333C) **Discrete-ordinates electron transport calculations using standard neutron transport codes.** Morel, J.E. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-791103—13). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The primary purpose of this work was to develop a method for using standard neutron transport codes to perform electron transport calculations. The method is to develop approximate electron cross sections which are sufficiently well-behaved to be treated with standard S/sub n/ methods, but which nonetheless yield flux solutions which are very similar to the exact solutions. The main advantage of this approach is that, once the approximate cross sections are constructed, their multigroup Legendre expansion coefficients can be calculated and input to any standard S/sub n/ code. Discrete-ordinates calculations were performed to determine the accuracy of the flux solutions for problems corresponding to 1.0-MeV electrons incident upon slabs of aluminum and gold. All S/sub n/ calculations were compared with similar calculations performed with an electron Monte Carlo code, considered to be exact. In all cases, the discrete-ordinates solutions for integral flux quantities (i.e., scalar flux, energy deposition profiles, etc.) are generally in agreement with the Monte Carlo solutions to within approximately 5% or less. The central conclusion is that integral electron flux quantities can be efficiently and accurately calculated using standard S/sub n/ codes in conjunction with approximate cross sections. Furthermore, if group structures and approximate cross section construction are optimized, accurate differential flux energy spectra may also be obtainable without having to use an inordinately large number of energy groups. 1 figure. (RWR)

55758 (UCRL—82268(Rev.1)) **Standards for the publication of powder patterns: the American crystallographic association subcommittee's final report.** Calvert, L.D.; Flippen-Anderson, J.L.; Hubbard, C.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1979. Contract W-7405-ENG-48. 45p. (CONF-790637—1(Rev.1)). Dep. NTIS, PC A03/MF A01.

From Symposium on accuracy in power diffraction; Washington, DC, USA (11 Jun 1979).

A subcommittee of the American Crystallographic Association (ACA) was formed to recommend some guidelines that would improve the overall quality of published powder diffraction data. An analysis of the Powder Diffraction File shows that many of the well-known techniques for obtaining good quality data are often not being applied, and hence there is a need for the establishment of publication standards. A major recommendation from this subcommittee is the use of a standard data-form at the author/referee level of publication. The proposed data-form is divided into five sections: sample characterizaton, technique, unit cell data, references, and the powder data. The information asked for in these five sections represents what, in most cases, the referee and editor can reasonably expect of experimenters seeking to publish their powder data. An example of a filled-out form is shown, and instructions for completing the form are given. Another recommendation is that the ACA request that the International Union of Crystallography consider implementing these recommendations in all IUCr journals.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 55453

55759 (BNL—25944) **Excitations and phase transitions in random anti-ferromagnets.** Cowley, R.A.; Birgeneau, R.J.; Shirane, G. (Edinburgh Univ. (UK); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 25p. (CONF-790487—3). Dep. NTIS, PC A02/MF A01.

From NATO advanced study Institute on ordering in strongly - fluctuating condensed - matter systems; Geilo, Norway (16 Apr 1979).

Neutron scattering techniques can be used to study the magnetic excitations and phase transitions in the randomly mixed transition metal fluorides. The results for the excitations of samples with two different types of magnetic ions show two bands of excitations; each associated with excitations propagating largely on one type of ion. In the diluted salts the spectra show a complex line shape and greater widths. These results are in good accord with computer simulations showing that linear spin wave theory can be used, but have not been described satisfactorily using the coherent potential approximation. The phase transitions in these materials are always smeared, but it is difficult to ascertain if this smearing is due to macroscopic fluctuations in the concentration or of an intrinsic origin. Studies of these systems close to the percolation point have shown that the thermal disorder is associated with the one-dimensional weak links of the large clusters. Currently theory and experiment are in accord for the two-dimensional Ising system but features are still not understood in Heisenberg systems in both two and three dimensions.

MEDICAL PHYSICS

DOSIMETRY

55760 (CONF-790728—4) **Effectiveness of the Heavy Ion Radiation Criterion as an index of accelerator radiation levels.** Lipton, W.V.; Hunckler, C.A.; Klochan, G.A.; Sprouse, L.H. Jr.; Heppeler, D.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dept. NTIS, PC A02/MF A01.

From 24. annual meeting of the Health Physics Society; Philadelphia, PA, USA (7 Jul 1979).

The research program of the Physics Division's tandem Van de Graaff accelerator facility at Argonne National Laboratory often requires entries into a target room while the accelerator beam is present, both to perform adjustments on an experiment in progress and to set up a future experiment on another beam line. To assure the safety of personnel, while permitting the maximum feasible freedom of movement, it is useful to have a means of predicting the maximum possible radiation levels in the target room for the planned operating conditions. This would assure thorough radiation surveys, by Health Physics personnel, when they are needed, while minimizing delays for low hazard experiments. Such a predictive index has been developed by John P. Schiffer, a Senior Physicist, at Argonne National Laboratory. It is called the Heavy Ion Radiation Criterion (HIRC). The authors have performed an empirical study of the effectiveness of the HIRC. From July, 1978 to May, 1979, the actual, measured radiation levels for accelerator experiments were compared with the calculated HIRC values. For each experiment, the radiation level used was the maximum measured dose equivalent rate (gamma plus neutron), in mrem/h. The results of these measurements are given.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 54326, 54327, 54331

55761 (LA-UR—79-2324) **Analysis of the macroscopic equations for second sound in solids.** Overton, W.C. Jr. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790862—1). Dep. NTIS, PC A02/MF A01.

From 3. international conference on phonon scattering in condensed matter; Providence, RI, USA (28 Aug 1979).

The microscopic theories of second sound in solids can be expressed in macroscopic form when the normal and resistive process phonon relaxation times tau/sub N/(ω,T) and tau/sub R/(ωT) have been averaged appropriately over all ω's. Thus, for a given temperature T, tau/sub N/(T) and tau/sub R/(T) can be regarded as fixed parameters. The macroscopic equations for the heat current in three dimensions can be expressed in one dimension. A method for solving this expression in closed form is presented. (GHT)

55762 (SAND—79-0581C) **Anode-initiated surface flashover.** Anderson, R.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-791028—1). Dep. NTIS, PC A02/MF A01.

From Conference on electrical insulation and dielectric phenomena; Whitehaven, PA, USA (21 Oct 1979).

Either of two distinctively different surface flashover mechanisms may lead to the electrical breakdown of an insulator under high voltage stress in vacuum. While the more familiar cathode-initiated mechanism propagates toward the anode and depends on secondary electron multiplication on the insulator surface, anode-initiated flashover propagates in the opposite direction and appears to involve processes related to bulk breakdown. The study of anode-initiated flashover may therefore help to elucidate the physics of the treeing mode of insulation failure. In addition, anode-initiated flashover very likely limits the electric field that can be withstood by conventionally designed insulators having surfaces inclined to avoid electron multiplication. In the work reported here, a variety of dielectric materials were subjected in vacuum (10^{-3} to 10^{-4} Pa pressure) to high voltage steps having 3 ns risetime. Damage patterns on the insulator surface characteristic of anode-initiated flashover occurred with various experimental arrangements having in common high electric fields directed into the surface of the insulator. The flashover mechanism was studied by detecting emission current from the insulator and by examining the surface damage with the aid of scanning electron microscopy. A model of the flashover mechanism based on these observations is proposed.

55763 (SAND—79-0812C) **Dynamics of the optically-induced properties of a small-polaronic glass.** Emin, D. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790851—1). Dep. NTIS, PC A02/MF A01.

From 8. international conference on amorphous and liquid semiconductors; Cambridge, MA, USA (27 Aug 1979).

The relaxation and recombination of an electronic excitation created by the absorption of a super-band-gap photon is considered for a system in which excitons and charge carriers find it energetically favorable to self-trap. The notions of a barrier to self-trapping, a short-range repulsion between electrons and holes, and the electromodulation of the small-polaron absorption band play a central role in this discussion. The results are consistent with experiments on chalcogenide glasses.

55764 (SAND—79-0823C) **Enhancement of injection current at the metal-insulator interface.** Hughes, R.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-790851—2). Dep. NTIS, PC A02/MF A01.

From 8. international conference on amorphous and liquid semiconductors; Cambridge, MA, USA (27 Aug 1979).

Very deep traps may exist in amorphous insulators near a metal interface. When such traps are populated by photocarriers, large distortions in the electric field at the contact may result in carrier injection. A model of the time dependence and magnitude of the injection current is developed and compared with experimental results for the $Si\text{-}SiO_2$ interface and the metal-PET (polyethyleneterephthalate) interface.

55765 (SAND—79-1150C) **Aims and accomplishments of surface theory.** Feibelman, P.J. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 28p. (CONF-791013—1). Dep. NTIS, PC A03/MF A01.

From 26. national vacuum symposium; New York, NY, USA (2 Oct 1979).

The goals of surface science include the understanding of surface structure, transport and chemistry. However, present activities are mainly focussed on the most basic problem, viz., what are the constituents of a given surface and where are they located. Theorists are approaching this surface characterization problem from two sides. To make better use of the data available from the many experimental surface probes, an understanding of the force laws which govern the motion of probe-particles near surfaces is being developed, and the relation between the excitation and ground state spectra of a solid are being studied. In order to develop a predictive capability regarding surface structure, a variety of intrinsic surface properties are being studied, including the nature of bonds at transition metal surfaces, the meaning of bond locality in extended systems, and the electronic factors underlying the forces which govern surface geometry. These studies often raise technical issues such as the validity of using local exchange-correlation potentials and the applicability of cluster calculations to the analysis of extended surface situations, which, however, should not obscure the main thrust of current work - empirical and predictive surface structure determination. These points are illustrated with examples from recent research and ways in which experimental surface work might assist theoretical efforts are indicated.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 55224, 55234

55766 (BNL—26542) **Superconductivity and atomic ordering in neutron-irradiated Nb_3Ge.** Cox, D.E.; Sweedler, A.R.; Moehlecke, S.; Newkirk, L.R.; Valencia, F.A. (Brookhaven National Lab., Upton, NY (USA); Los Alamos Scientific Lab., NM (USA)). 1979. Contract EY-76-C-02-0016. 13p. (CONF-790653—14). Dep. NTIS, PC A02/MF A01.

From Superconductivity in d- and f-band metals; San Diego, CA, USA (21 Jun 1979).

The effects of high energy ($E > 1$ MeV) neutron irradiation on the properties of Nb_3Ge prepared by chemical vapor deposition have been studied. Irradiation to a fluence of 3.4×10^{19} n/cm^2 produces a decrease in the superconducting transition temperature T/sub c/ from 20.9 to 4.4 K and in the long-range order parameter S from 0.86 to 0.46, and an increase in the lattice parameter a_0 from 5.142 A to 5.174 A. For a fluence of 6.5×10^{19} n/cm^2, most of the Nb_3Ge is transformed into a noncrystalline phase. The A15 phase is recovered after annealing.

55767 (LA-UR—79-1789) **Giant moments in Pd(Mn,Co) alloys.** Taylor, R.D.; Willis, J.O. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790940—1). Dep. NTIS, PC A02/MF A01.

From International conference on mossbauer spectroscopy; Portoroz, Yugoslavia (10 Sep 1979).

Near T/sub M/, the large effective moment on Fe in the Pd(Co,Mn) alloys provides a high sensitivity ME magnetic field probe. For the $Pd_{0.99}Mn_{0.01}$ alloy, peak sensitivity occurs in the 6.5 to 10°K range, but T/sub M/, and therefore the region of high field sensitivity, can easily be shifted by changing the Co or Mn concentration. These probes represent an order of magnitude improvement in sensitivity over the Pd ME probes previously used, and they should be quite useful in magnetic field profiling at cryogenic temperatures.

55768 (LA-UR—79-2135) **Quenches in the superconducting magnet CELLO.** Hassenzahl, W.V. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 20p. (CONF-790815—17). Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

The superconducting magnet CELLO was tested with currents up to 3200 A at Saclay and has been installed at DESY in Hamburg where it will be used for particle physics experiments requiring colliding beams of electrons and positrons. The testing of this unique, large, one-layer solenoid provides an excellent opportunity to evaluate the theory of quench propagation under adiabatic conditions, that is, in a coil in which the conductors are not in direct contact with helium. In an early test of this coil, quenches that occurred, gives the details of the damaged conductor, and includes an analysis of the quenches. Observed axial quench velocities are compared to the calculated values based on both measurements and calculations of the thermal conductivity of the fabricated coil.

55769 (SAN—0034-T5) **Theory of low dimensional superconductors. Biannual report.** Simanek, E. (California Univ., Riverside (USA). Dept. of Physics). Jul 1979. Contract EY-76-S-03-0034-233. 23p. Dep. NTIS, PC A02/MF A01.

The results of works completed during the period June 1, 1977-July 31, 1979 are outlined. The DOE-research project for this period, Theory of Low Dimensional Superconductors, was initiated at the beginning of 1977 in an attempt to explain the anomalies of the behavior of the order parameter in inhomogeneous superconducting films and the nuclear spin relaxation measurements in Al and Sn fine particle samples. Two major contributions emerged out of these efforts. The first is concerned with the calculation of the order parameter in an inhomogeneous superconductor. In the other, a theory of the thermodynamic order parameter fluctuations in small superconducting grains coupled by Josephson coupling was developed. A detailed description of these results is presented. Subsequent efforts were aimed into the area of superconducting alloys with high Kondo temperature such as Al-Mn, Al-V, and Al-Cr.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

55770 (ANL—79-50) **Ergodic theorems for nonlinear contraction semigroups in a Hilbert space.** Kaper, H.G.; Leaf, G.K. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 20p. Dep. NTIS, PC A02/MF A01.

Two ergodic theorems are presented for means of nonlinear contraction semigroups in a Hilbert space. These means are generated by a class of averaging kernels which includes the usual Abel and Cesaro-(C,α) kernels. 7 references.

55771 **Bell's theorem: experimental tests and implications.** Clauser, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Shimony, A. *Rep. Prog. Phys.;* **41**: No. 12, 1881-1927(Dec 1978).

Bell's theorem represents a significant advance in understanding the conceptual foundations of quantum mechanics. The theorem shows that essentially all local theories of natural phenomena that are formulated within the framework of realism may be tested using a single experimental arrangement. Moreover, the predictions by these theories must significantly differ from those by quantum mechanics. Experimental results evidently refute the theorem's predictions for these theories and favour those of quantum mechanics. The conclusions are philosophically startling: either one must totally abandon the realistic philosophy of most working scientists, or dramatically revise our concept of space-time. 73 references.

RELATIVITY AND GRAVITATION

REFER ALSO TO CITATION(S) 55743

ELECTRICITY AND MAGNETISM

REFER ALSO TO CITATION(S) 55773

55772 (LBL—9627) **Solution of the general magnetostatic equation. Progress report.** Colonias, J.S.; Friedman, M.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

Work on the formulation and solution of the non-linear magnetostatic equation is summarized, and efforts towards design and implementation of a computer program to solve this equation efficiently are described. (GHT)

MATHEMATICAL PHYSICS

55773 (LBL—9504) **Finite element method for the solution of a potential theory integral equation.** Friedman, M.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

A finite element approximation for an integral equation of the second kind deduced from a potential theory boundary-value problem in two variables is discussed. The equation is shown to admit a unique solution, to be variational and coercive in the Hilbert space of functions σ an element of H/sup 1/2/(Γ), integral/sub Γ/σ dγ = 0. The Galerkin method with finite elements as trial functions is shown to lead to an optimal rate of convergence.

FUSION ENERGY

PLASMA RESEARCH

55774 (INIS-mf—4691, pp 67-74) **Fusion technology (FT).** 1978. (In German).

In Progress report on research and development in 1977.

The annual report of the fusion technology (FT) working group discusses the projects carried out by the participating institutes in the fields of 1) fuel injection and plasma heating, 2) magnetic field technology, and 3) systems investigations.

PLASMA CONFINEMENT AND HEATING

55775 (COO—2218-133) **Monte Carlo simulation of neutral-beam injection for mirror fusion reactors.** Miller, R.L. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-S-02-2218. 154p. Dep. NTIS, PC A08/MF A01.

Thesis.

Computer simulation techniques using the Monte Carlo method have been developed for application to the modeling of neutral-beam intection into mirror-confined plasmas of interest to controlled thermonuclear research. The energetic (10 to 300 keV) neutral-beam particles interact with the target plasma (T/sub i/ ~ 10 to 100 keV) through electron-atom and ion-atom collisional ionization as well as ion-atom charge-transfer (charge-exchange) collisions to give a fractional trapping of the neutral beam and a loss of charge-transfer-produced neutrals which escape to bombard the reactor first wall. Appropriate interaction cross sections for these processes are calculated for the assumed anisotropic, non-Maxwellian plasma ion phase-space distributions.

55776 (COO—2456-T11) **High-beta tokamak research Torus I and Torus II. Quarterly status report, 1 April-30 June 1978.** Gross, R.A. (Columbia Univ., New York (USA). Plasma Lab.). 6 Jul 1978. Contract EY-76-S-02-2456. 4p. Dep. NTIS, PC A02/MF A01.

Status of the high-beta tokamak research program at Columbia University is reported for the period 1 April through 30 June 1978. Activities on Torus I Belt Pinch and Torus II high beta tokamak are discussed. Engineering improvements, budget, schedule personnel and capital equipment considerations are also presented.

55777 (GA-A—15232, pp 5.1-5.69) **Doublet IIA.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

A brief review of the Doublet-2A device, which is dedicated to the study of plasma heating by rf waves as an alternative to neutral beam heating, is presented. A detailed discussion of the rf heating experiments on this device, including coupling considerations and launching of waves, bulk and tail heating and future plans, is given. Support activities are also mentioned. These include machine modifications to permit constant plasma current programming, programming of the plasma position, installation of a gas puffing system and B-coil bracing. Diagnostic capabilities and low frequency heating of doublets are summarized.

55778 (LA—7935-MS) **Parametric study of the Tormac fusion reactor concept.** Miller, R.L.; Krakowski, R.A.; Bathke, C.G. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 63p. Dep. NTIS, PC A04/MF A01.

A preliminary but comprehensive power balance for the D-T Tormac magnetic fusion reactor concept is examined parametrically in order to establish general scaling relationships, tradeoffs, and constraints. The results are based on the simplifying assumptions of steady-state operation, a homogeneous plasma, and ideal thin-sheath, mirror-like confinement. Crucial physics uncertainties requiring further theoretical and experimental research attention are identified. Representative reactor physics operating points are generated to illustrate anticipated Tormac reactor embodiments. This study should be considered preliminary to a more detailed physics and technology modeling effort and is intended only to scope and identify possible operating points, parametric sensitivities, and potential physics/technological problems.

55779 (ORNL/TM—6584/R1) **Scaling studies of beam-heated tokamaks.** Scott, S.D.; Sheffield, J. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

Parametric scaling of neutral beam-heated tokamaks is examined to determine the trade-off between beam energy and power. It is shown that when the plasma thermal conductivity is inversely proportional to the local density, the center mean plasma temperature is a function of P/sub A/E/sub B//sup δ/, where E/sub B/ and P/sub A/ are the beam energy and incident beam power per unit area, respectively. The parameter, δ, which depends only upon the plasma density profile, is of order unity.

55780 (ORNL/TM—6992) **Theoretical study of electron-cyclotron heating in elmo bumpy torus.** Batchelor, D.B.; Goldfinger, R.C. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 61p. Dep. NTIS, PC A05/MF A01.

The basic features of microwave propagation and electron-cyclotron damping in ELMO Bumpy Torus (EBT) devices are investigated to provide an understanding of the heating of the toroidal core plasma component. The characteristics of microwave propagation in EBT geometry, where there is strong variation of absolute value B along field lines, are described and contrast is made with the electron-cyclotron heating (ECH) of tokamaks. Linear cyclotron damping calculations are presented for plasmas having parameters typical of EBT-I and parameters projected for EBT-II. It is shown that tye extraordinary mode is completely absorbed near the fundamental cyclotron resonance when propagating from the high magnetic field side (mirror throat).

55781 (PPPL—1567) **Formation of thermal eddies during rf heating of plasma.** Motley, R.W.; Hooke, W.M.; Anania, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1979. Contract EY-76-C-02-3073. 15p. Dep. NTIS, PC A02/MF A01.

Moderate power (~1 kW) excitation of lower hybrid waves in a linear plasma column is found to increase the reflectivity of the phased waveguide exciter and to change the vertical position of the resonance cone. Probing of the plasma near the mouth of the waveguide reveals that the increased reflection results from an undulation in the plasma surface. We present evidence that this surface distortion is driven by thermal eddies associated with asymmetrical electron heating.

55782 (PPPL—1584) **Steady-state currents driven by collisionally damped lower hybrid waves.** McWilliams, R.; Valeo, E.J.; Motley, R.W.; Hooke, W.M.; Olson, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1979. Contract EY-76-C-02-3073. 16p. Dep. NTIS, PC A02/MF A01.

Low power (< 50 W) lower hybrid waves excited in a linear plasma were observed to drive electron currents (a few mA/W) in the direction of the wave momentum when the waves were collisionally damped. An approximate solution of an electron kinetic equation with a Lorentz collision operator predicts an electron current in this experimental regime (k/sub "/v/sub t//ω ~ ν/ω << 1).

55783 (SAND—79-1481C) **Initial operation of PDX.** Meade, D.; Arunasalam, W.; Barnes, C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1979. Contract EY-76-C-04-0789. 6p. (CONF-790912—2). Dep. NTIS, PC A02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

Initial operation of PDX with a circular cross-section plasma is described. The machine parameters are given and the glow discharge cleaning is discussed. Plasma parameters for a circular deuterium plasma discharge are given for both moderate and low q experiments.

55784 (UCRL—52759) **Review of electron-beam heating of magnetic-mirror confined plasmas, with application to the Tandem Mirror Experiment.** Seidl, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1979. Contract W-7405-ENG-48. 43p. Dep. NTIS, PC A03/MF A01.

This report reviews results from early electron-beam heating experiments and more recent basic beam-plasma physics experiments as well as present theoretical understanding. We find tha rather simple electron-beams could be employed on the Tandem Mirror Experiment (TMX) at Lawrence Livermore Laboratory to carry out electron heating experiments.

PLASMA DIAGNOSTICS

55785 (COO—2387-104) **Stimulated Thomson scattering.** Spencer, R.L. (Wisconsin Univ., Madison (USA)). Mar 1979. Contract EY-76-S-02-2387. 150p. Dep. NTIS, PC A07/MF A01.

Thesis.

The theory of stimulated Thomson scattering is investigated both quantum mechanically and classically. Two monochromatic electromagnetic waves of like polarization travelling in opposite directions are allowed to interact for a time tau with the electrons in a collisionless plasma. The electromagnetic waves have frequencies well above the plasma frequency, and their difference frequency is allowed to range upward from the plasma frequency. With the difference frequency well above the plasma frequency, the rate at which energy is transferred from one wave to the other is calculated quantum mechanically, classically from a fluid theory, and classically from an independent electron theory. The rate is calculated in both the homogeneously broadened limit, and in the inhomogeneously broadened limit.

55786 (COO—4541-1) **Soft x-ray imaging on Alcator.** (American Science and Engineering, Inc., Cambridge, MA). May 1979. Contract EG-77-C-02-4541. 54p. (ASE—4422). Dep. NTIS, PC A04/MF A01.

The development of an advanced uv/x-ray plasma imaging system for the study and control of plasma in the Alcator A tokamak at MIT is discussed. The importance of tomographic imaging systems for reconstructing two-dimensional plasma images is considered. The feasibility of using tomographic techniques for mapping the internal structures of plasmas is considered for Alcator C and TMX. The design, execution and analysis of an x-ray experiment on the MIT magnetic mirror machine are discussed. A series of plasma studies on Alcator A are presented.

55787 (GA-A—15232, pp 3.1-3.119) **Doublet III experiment.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

An overview of the Doublet-3 physics is presented. Detailed discussions are given on the topics of the plasma experiments performed on Doublet-3, plasma equilibrium calculations and magnetic data analysis, impurity control, high density plasma operation, transport in Doublet-3 and neutral beam physics. The diagnostics on Doublet-3 are discussed, including magnetic diagnostics, hard x-ray monitors, plasma photography, microwave interferometers, Thomson scattering (system A), visible spectroscopy, soft x-ray energy spectrometer, soft x-ray fluctuations, and electron cyclotron radiometers.

55788 (ORNL—5549, pp 1-39) **Experimental confinement.** Amano, T.; Anderson, J.L.; Appleton, B.R. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The following areas of EBT research are described: (1) soft x-ray measurements, (2) charge exchange measurements, (3) Thomson scattering, (4) heavy ion beam probe, (5) toroidal plasma impurities from v-uv emissions, (6) toroidal current and global field compensation, (7) absorption of the ordinary wave in finite temperature EBT plasma, (8) EBT-II, (9) the 28-GHz oversized waveguide development, and (10) wall effects on the absorption of electron cyclotron waves in an EBT plasma. Tokamak research during this period consisted of the following: (1) ISX-A, (2) ISX-B, (3) impurity study program, and (4) long pulse technology tokamak. (MOW)

55789 (ORNL—5549, pp 41-43) **Diagnostic development.** Barnett, C.F. (Univ. of Mississippi, University); Hutchinson, D.P.; Ma, C.H.; Ray, J.A.; Staats, P.A.; Stelson, P.H.; Vander Sluis, K.L.; Van Zyl, B. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

Further investigations of the unstable resonator-oscillator spectral characteristics of the 1-MW D_2O ion Thomson scattering laser have indicated the presence of transverse mode structure. To eliminate these unwanted frequencies, the laser configuration was changed to a linear oscillator with mode-selecting optics. The formic acid submillimeter-laser, single-channel interferometer was operated successfully on the second phase of the Impurity Study Experiment (ISX-B) and was expanded to multichannels to include plasma current density measurements using Faraday rotation of the polarization vector. A fast H atom secondary emission detector was calibrated in the energy range of 30 eV-2.5 keV by photodetaching H^- to provide a known beam of H^0. Preliminary plasma ion temperature measurements were made in ISX-B through liquid oxygen.

PLASMA KINETICS - GENERAL

REFER ALSO TO CITATION(S) 55918

55790 (ORNL—5549, pp 183-188) **Management services.** Adkins, S.K.; Alford, D.R.; Barnette, A.B. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The Management Services Section provides coordinated professional administrative services to the Fusion Energy Division (FED), allowing the work of technical professionals to be more fully concentrated in their areas of specialty. Services are provided in general administration, personnel, financial management, communications (including text and graphics generation), management infor-

mation, library, safety, quality assurance, and nonprogrammatic engineering services. Highlights of the past year included adoption of the Procurement Module in the FED Management Information System (MIS) for use by the entire Laboratory, completion of the Personnel Module of the MIS, greatly increased personnel recruiting activity, and increased industrial subcontracting activity.

PLASMA KINETICS - EXPERIMENTAL

55791 (ORNL—5549, pp 97-103) **Atomic, molecular, and nuclear physics.** Barnett, C.F.; Crandall, D.H.; Dunn, G.H. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

A crossed-beams apparatus has been used to obtain the sum of the charge exchange and ionization cross sections of 40-keV H^0 with N^{3+}. Electron impact ionization cross sections were extended to the multiply charged ions B^{3+}, C^{3+}, C^{4+}, N^{3+}, N^{4+}, N^{5+}, O^{3+}, O^{4+}, O^{5+}, and Ar^{4+} in the energy range from threshold to 1500 eV. The data indicate that for the lithium-like ions, excitation followed by autoionization contributes significantly to the ionization cross sections. For the ions studied, this contribution increased with the ion charge.

55792 (PPPL—1591) **Observed magnetic dipole transitions in the ground terms of Ti XIV, Ti XV, and Ti XVII.** Suckewer, S.; Fonck, R.; Hinnov, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1979. Contract EY-76-C-02-3073. 13p. Dep. NTIS, PC A02/MF A01.

Four observed spectrum lines in titanium-containing tokamak discharges have been identified as follows: TiXIV $2s^22p^5\ ^2P/sub\ 1/2/ \rightarrow\ ^2P/sub\ 3/2/$ at 2115.3 A, TiXV $2s^22p^4\ ^3P_1 \rightarrow\ ^3P_2$ at 2544.8 A, TiXVII $2s^22p^2\ ^3P_2 \rightarrow\ ^3P_1$ at 3834.4 A and $^3P_1 \rightarrow\ ^3P_0$ at 3371.5 A. The identifications are based on observed time behavior and correlation with intensities of resonance lines of other titanium ions, and on general agreement with predicted wavelengths and intensities.

PLASMA KINETICS - THEORETICAL

55793 (COO—2218-83) **Effects of suprathermal fusion particles in tokamak plasmas.** Petrie, T.W. (Illinois Univ., Urbana (USA). Graduate Coll.). 1978. Contract EY-76-S-02-2218. 156p. Dep. NTIS, PC A08/MF A01.

Thesis.

Several crucial properties of suprathermal (> 500 keV) fusion-products are explored, both in their initial phase and during their slowing-down period. A guiding center drift theory, which predicts the effect of energy loss on the motion of these suprathermals, is derived for a low-β, symmetric (non-ripple) tokamak. Velocity-space scattering is ignored. Among the important implications of this theory are: (1) the net inward drift of fusion particles during their slow-down phase and (2) the importance of the plasma density and temperature in determining this drift. The effect the inward drifting has on the spatial profile for the suprathermals approaching thermal energies, on the energy distribution, and on the plasma heating profile is demonstrated for five reactor cases, ranging from near-term low-current devices to conceptual power reactors.

55794 (GTFR—7) **Fusion control studies: impurity control by neutral beam injection.** Stacey, W.M. Jr.; Sigmar, D.J. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering; Oak Ridge National Lab., TN (USA)). 21 Jun 1979. Contract ET-78-S-05-5683. 25p. Dep. NTIS, PC A02/MF A01.

A recently developed generalizationn of neoclassical theory is applied to study the use of neutral beam injection to drive impurities out of a tokamak plasma. The theory accounts for the direct momentum exchange between beam and plasma, which has been studied previously, and also for the effects of the beam in altering the first-order particle flows and the ambipolar potential. Conditions are established for which coinjection drives impurity fluxes outward. It is estimated that order-unity changes of the radial impurity flow should be found in current experiments and that modest levels of neutral beam injection should suffice for impurity control in reactors. In the course of this work, the general theory of particle transport in the presence of particle and momentum sources is evaluated for a two-species plasma with arbitrary plasma geometry and beta.

55795 (GTFR—8) **Fusion control studies: interim report on divertor and gas blanket impurity control study.** El Derini, Z.; Stacey, W.M. Jr. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 21 Jun 1979. Contract ET-78-S-05-5683. 54p. Dep. NTIS, PC A04/MF A01.

A simple calculational model for the transport of particles across the scrape off region between the plasma and the wall in the presence of a divertor or a gas blanket has been developed. The variation of the divertor or gas blanket performance as a function of the heat and particle fluxes escaping from the plasma, the wall material and the cross field diffusion is examined and numerical examples are given. This work contributes to an understanding of the divertor and gas blanket parameters that are required in order to efficiently shield the plasma and it also helps to indicate new methods for improving the effectiveness of divertors and gas blankets.

55796 (ORNL—5549, pp 45-96) **Plasma theory.** Amano, T. (Osaka Univ., Japan); An, C.H.; Arnurius, D.E. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

Among the broad spectrum of advances made by the Theory Section in the understanding of tokamaks and the ELMO Bumpy Torus (EBT), the following stand out as items of special importance to the fusion program: (1) The high beta tokamak approach pioneered and made credible at Oak Ridge National Laboratory (ORNL) has culminated in the demonstration of (1) stable equilibria at beta values as high as 10% for aspect ratio 4, (2) longevity of high beta cases in the presence of resistive skin diffusion, and (3) benign reaction the the full range of transport phenomena. For the EBT device, the simplified stability criteria previously used have been substantiated through more detailed analysis of kinetic effects, and most of the primary experimental observations have been explained on the basis of neoclassical transport theory.

55797 (ORNL/TM—6948) **Two-dimensional electrostatic E Vector x B Vector trapping.** Hirshman, S.P. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 23p. Dep. NTIS, PC A02/MF A01.

The nonlinear motion of a charged particle in a uniformly magnetized, two-dimensional plasma is analyzed in the presence of finite amplitude electrostatic waves traveling in the plane perpendicular to the magnetic field. In a strongly magnetized plasma, no particle trapping occurs in a single electrostatic traveling wave of arbitrary amplitude, since the induced E Vector x B Vector motion is orthogonal to the direction of wave propagation. However, particle orbits can be trapped when there are at least two mutually orthogonal components of the electrostatic field with finite wave amplitude $E/sub\ perpendicular/B \geq \omega/k/sub\ perpendicular/$ such that a particle drifts one wavelength in a wave period. This threshold amplitude for strong nonlinear behavior coincides with and helps to explain the many-wave turbulence criterion for the onset of particle diffusion in a two-dimensional plasma.

55798 (UCRL—82349) **Finite mean-free-path effects on axial particle transport in mirror devices.** Rognlien, T.D.; Cutler, T.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jun 1979. Contract W-7405-ENG-48. 6p. (CONF-790912—4). Dep. NTIS, PC A02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

The problem of collisional particle and energy transport in open-ended systems, where the axial transport is dominant, is considered. The Fokker-Planck equation for the distribution function has previously been solved in two limits: when the mean-free-path $\lambda/sub\ mfp/$ is long compared to the system length L, and when $\lambda/sub\ mfp/ << L$. A Monte Carlo procedure is presented for the solution of the equation which is formally valid for any range of $\lambda/sub\ mfp/L$, although it is most practical for $\lambda/sub\ mfp/ \sim L$. Results are given for two problems relevant to mirror devices at Lawrence Livermore Laboratory, namely, electron confinement in 2XIIB and ion confinement in the tandem mirror TMX.

PLASMA INSTABILITIES

55799 (COO—2218-T1) **Stability of the field-reversed mirror.** Morse, E.C. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-S-02-2218. 108p. Dep. NTIS, PC A06/MF A01.

Thesis.

The stability of a field reversed mirror plasma configuration is studied with an energy principle derived from the Vlasov equation. Because of finite orbit effects, the stability properties of a field-reversed mirror are different from the stability properties of similar magnetohydrodynamic equilibria. The Vlasov energy principle developed here is applied to a computer simulation of an axisymmetric field-reversed mirror state. It has been possible to prove that the $l = 0$ modes, called tearing modes, satisfy a sufficient condition for stability. Precessional modes, with $l = 1, 2$, are found to be unstable at low growth rate. This suggests possible turbulent behavior (Bohm confinement) in the experimental devices aiming at field reversal. Techniques for suppressing these instabilities are outlined, and the applicability of the Vlasov energy principle to more complicated equilibrium models is shown.

55800 (COO—2456-56) **Imploding to equilibrium of helically symmetric theta pinches.** Sharky, N.N. (Columbia Univ., New York (USA). Plasma Lab.). 1978. Contract EY-76-S-02-2456. 137p. Dep. NTIS, PC A07/MF A01.

Thesis.

The time-dependent, single-fluid, dissipative magnetohydrodynamic equations are solved in helical coordinates (r,phi), where $phi = \Theta - kz$, $k = 2\pi/L$ and L is the periodicity length

in the z-direction. The two-dimensional numerical calculations simulate theta pinches which have an $l = 1$ helical field added to them. Given the applied magnetic fields and the initial state of the plasma, we study the time evolution of the system. The plasma is found to experience two kinds of oscillations, occurring on different time scales. These are the radial compression oscillations, and the slower helical oscillations of the plasma column. The plasma motion is followed until these oscillations disappear and an equilibrium is nearly reached. Hence given the amplitude and the rise time of the applied magnetic fields, the calculations allow one to relate the initial state of a cold, homogeneous plasma to its final equilibrium state where it is heated and compressed.

55801 (COO—3004-24) **Is transient growth in a current-carrying plasma possible.** Schmidt, G. (Stevens Inst. of Tech., Hoboken, NJ (USA)). Apr 1979. Contract EY-76-S-02-3004. 5p. Dep. NTIS, PC A02/MF A01.

The transient growth of a shear Alfven wave in a current carrying plasma of infinite conductivity is investigated. It is shown theoretically that no large amplitudes exist. (MOW)

55802 (GA-A—15232, pp 8.1-8.78) **Fusion plasma theory.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

The MHD equilibrium and stability in noncircular tokamaks is discussed in detail. Transport models of tokamaks in one and two dimensions are considered and applications to doublet are given. Empirical scaling laws for the density-average electron temperature and energy confinement time are presented. Auxiliary heating of tokamaks with rf power is discussed. A brief summary of fundamental theoretical studies of general applicability is included. Finally, code development, including plasma transport and stability codes, is discussed, and the tasks and activities of the user service center are mentioned.

55803 (PPPL—1580) **MHD equilibrium and stability of the spheromak.** Okabayashi, M.; Todd, A.M.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1979. Contract EY-76-C-02-3073. 28p. Dep. NTIS, PC A03/MF A01.

The MHD stability of spheromak type equilibria from the classical spheromak configuration to the diffuse pinch limit are analyzed numerically. It is found that oblate configurations of ellipticity 0.5 have the optimum stability properties with regard to internal MHD modes and can be stabilized up to an engineering β of 15% (defined with respect to the applied external field strength for equilibrium). Stability to global modes requires that a conducting shell surround the plasma. The location of the shell is dependent on geometry and the current profile, but realistic configurations that are stable to all ideal MHD modes have been found with the shell located at $\sim$ 1.2 minor radii.

55804 (PPPL—1587) **WKB theory for high-n modes in axisymmetric toroidal plasmas.** Dewar, R.L.; Chance, M.S.; Glasser, A.H.; Greene, J.M.; Frieman, E.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1979. Contract EY-76-C-02-3073. 16p. Dep. NTIS, PC A02/MF A01.

It is demonstrated that the low-frequency, k/sub parallel//k/ sub perpendicular/ $\simeq$ 0 normal modes of an axisymmetric plasma, at large but finite toroidal mode number n, can be obtained by solving a novel WKB problem involving an infinite number of branches. Formulae for the frequencies of periodic normal modes are derived. The analysis is performed in the context of an ideal MHD model, and comparison is made with numerical ballooning mode results.

PLASMA WAVE PHENOMENA

55805 (LA-UR—79-2394) **Experiments on the interaction of electromagnetic waves with a fully-ionized plasma.** Banton, M.E.; Dreicer, H.; Ingraham, J.C.; Wright, B.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-7906122—1). Dep. NTIS, PC A02/MF A01.

From Mini-conference on microwave modeling of laser plasma interactions; Redondo Beach, CA, USA (27 Jun 1979).

Work is summarized on microwave studies of interest to the laser-plasma problem. Current studies are in the field of electron heat transport and also involve resonator techniques. (MOW)

FUSION POWER PLANT TECHNOLOGY

55806 (DOE/ET—0104) **Advanced fusion concepts project summaries.** (Department of Energy, Washington, DC (USA)). Jun 1979. 79p. Dep. NTIS, PC A05/MF A01.

The activities of all the projects supported by the Advanced Fusion Concepts Branch of the Office of Fusion Energy, DOE, are described. These descriptions are project summaries of each of the individual projects, and contain title, persons responsible, funding, purpose, approach, recent progress, future plans, planned milestones, graduate students and other staff, and recent publications.

55807 (EPRI-ER—1083(Vol.1)) **Design study of a fusion-driven tokamak hybrid reactor for fissile fuel production. Final report.** Rose, R.P. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). May 1979. 279p. Dep. NTIS, PC A13/MF A01.

This study evaluated conceptual approaches for a tokamak fusion-driven fuel producing reactor. The conceptual design of this hybrid reactor was based on using projected state-of-the-art technology for the late 1980s. This reactor would be a demonstration plant and, therefore, first-of-a-kind considerations have been included. The conceptual definitions of two alternatives for the fusion driver were evaluated. A Two-Component Tokamak (TCT) concept, based on the TFTR plasma physics parameters, was compared to a Beam-Driven Thermonuclear (BDTN) concept, based on the USSR T-20 plasma physics parameters.

55808 (EPRI-NP—1083(Vol.2)) **Design study of a fusion-driven tokamak hybrid reactor for fissile fuel production. Final report.** Rose, R.P. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). May 1979. 268p. Dep. NTIS, PC A12/MF A01.

This study evaluated conceptual approaches for a tokamak fusion-driven fuel producing reactor. The conceptual design of this hybrid reactor was based on using projected state-of-the-art technology for the late 1980s. This reactor would be a demonstration plant and, therefore, first-of-a-kind considerations have been included. The conceptual definitions of two alternatives for the fusion driver were evaluated. A Two-Component Tokamak (TCT) concept, based on the TFTR plasma physics parameters, was compared to a Beam-Driven Thermonuclear (BDTN) concept, based on the USSR T-20 plasma physics parameters.

55809 (GA-A—15232) **Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.** (General Atomic Co., San Diego, CA (USA)). Apr 1979. Contract EY-76-C-03-0167-038. 765p. Dep. NTIS, PC A99/MF A01.

This report contains an introduction and 8 separately abstracted articles about the Fusion Program at General Atomic Company, San Diego, CA, which is supported by the US Department of Energy. Progress during FY 1978 is reviewed, which includes the completion of the Doublet-3 tokamak, lower hybrid heating experiments on Doublet-2A, impurity control on ISX, and various theoretical and technological developments.

55810 (GA-A—15232, pp 2.1-2.41) **Doublet III construction and engineering test.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

Progress during FY-78 on the construction and operation of the Doublet III is reported. Detailed discussions about the installation and testing of various components and subsystems, including the B-coil, E-coil, F-coils and support structure, vacuum vessel, vacuum pumping system, limiter, thermal insulation blanket, control system, B-coil power system, E-coil power system, F-coil power system, and motor-generator, are presented. A brief review of the engineering test operation is given.

55811 (GA-A—15232, pp 6.1-6.146) **TNS Program.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

The fusion program plan is briefly reviewed and the role of the prototype experimental power reactor, thought of as The Next Step (TNS), is discussed. The required device capabilities and basic reactor concepts for a TNS fusion electric plant are given. A detailed discussion of the physics considerations for the Power Generating Fusion Reactor (PGFR), including plasma heating, MHD equilibrium and stability, burn control resulting from toroidal field ripple, fueling, and boundary effects, is presented. Engineering considerations of the major PGFR systems, as well as diagnostics, instrumentation, control, and programmatic issues are also considered in detail. It is concluded that TNS design studies have established the existence of a technical basis for constructing a long pulse, D-T burning tokamak to be operational prior to 1990.

55812 (GA-A—15232, pp 7.1-7.40) **ISX Research Program.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

A brief review of the highlights of the Impurity Study Experiment is given. Experimental results are presented for the impurity flow reversal experiment and wall conditioning by low power discharge cleaning. Results of the analytic theory for trace impurity transport in a dirty plasma are presented. The impurity transport code is discussed and an analysis of impurity flow reversal data is given. An explanation is given for the poloidal asymmetry of impuri-

ty line emission in collisional tokamak plasmas and future experiments are considered.

55813 (LA—7592-MS, pp 3.1-3.28) **Development of fusion energy: present and future.** Apr 1979.

In Production of synthetic gas from nuclear energy sources.

The current program status is reviewed. The magnetic fusion program, TFTR, and the inertial confinement program are discussed. Some technological requirements are also described. (MOW)

55814 (LA—7973-MS) **Reversed-Field Pinch Reactor (RFPR) concept.** Hagenson, R.L.; Krakowski, R.A.; Cort, G.E. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 217p. Dep. NTIS, PC A10/MF A01.

A conceptual engineering design of a fusion reactor based on plasma confinement in a Reversed-Field Pinch (FRP) configuration is presented. A 50% atomic mixture of deuterium and tritium (DT) is ohmically heated to ignition by currents flowing in the toroidal plasma; this plasma current also inherently produces the confining magnetic fields in a toroidal chamber having a major and minor radii of 12.7 and 1.5 m, respectively. The DT plasma ignites in 2 to 3 s and burns at 10 to 20 keV for ~ 20 s to give a fuel burnup of ~ 50%. Tritium breeding occurs in a granular Li_2O blanket which is packed around an array of radially oriented coolant tubes carrying a mixture of high-pressure steam and water. The slightly superheated steam emerging from this blanket would be used to drive a turbine directly. Low-pressure helium containing trace amounts of oxygen is circulated through the packed Li_2O bed to extract the tritium. A 20-mm-thick copper first wall serves as a neutron multiplier, acts as a tritium barrier, and supports image currents to provide plasma stabilization on a 0.1-s timescale; external windings provide stability for longer times.

55815 (ORNL—5549) **Fusion Energy Division annual progress report, period ending December 31, 1978.** (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 229p. Dep. NTIS, PC A11/MF A01.

Separate abstracts were prepared for each of the 10 included sections. (MOW)

55816 (ORNL—5549, pp 139-156) **Advanced systems.** Becraft, W.R. (General Electric Co., Schenectady, NY); Bettis, E.S.; Brown, T.G. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The Advanced Systems Program includes six major activities: (1) The Next Step (TNS) Program, (2) the Engineering Test Facility (ETF) Design Center, (3) the Fusion Power Demonstration Study, (4) the Committed Site Evaluation, (5) the Tokamak Instrumentation and Controls (I and C) Study, and (6) the Large Aspect Ratio Tokamak Study (LARTS).

55817 (ORNL/TM—6722) **Oak Ridge TNS Program: technical needs assessment.** Becraft, W.R.; Brown, T.G.; Reid, R.L. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 95p. Dep. NTIS, PC A05/MF A01.

This document highlights the technical requirements of the key subsystems of the Reference Design for The Next Step (TNS) and presents a preliminary assessment of the adequacy of the technical capabilities available to satisfy these requirements. Additional information on the Reference Design and the FY 1978 TNS Program activities can be found in the associated technical memoranda, ORNL/TM-6720, ORNL/TM-6721, and ORNL/TM-6723 - ORNL/TM-6733.

55818 (PPPL—1525) **PITR: Princeton Ignition Test Reactor.** (Princeton Univ., NJ (USA). Plasma Physics Lab.; Grumman Aerospace Corp., Bethpage, NY (USA)). Dec 1978. Contract EY-76-C-02-3073. 263p. Dep. NTIS, PC A12/MF A01.

The principal objectives of the PITR - Princeton Ignition Test Reactor - are to demonstrate the attainment of thermonuclear ignition in deuterium-tritium, and to develop optimal start-up techniques for plasma heating and current induction, in order to determine the most favorable means of reducing the size and cost of tokamak power reactors. This report describes the status of the plasma and engineering design features of the PITR. The PITR geometry is chosen to provide the highest MHD-stable values of beta in a D-shaped plasma, as well as ease of access for remote handling and neutral-beam injection.

BLANKET ENGINEERING

55819 (BNL—26494) **Fluid wall reactor systems for impact fusion.** Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 33p. (CONF-790741—5). Dep. NTIS, PC A03/MF A01.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

The functions required of impact fusion reactor vessels are discussed. Blanket options for impact fusion reactors are summarized. An analysis of fluid wall reactor systems for impact fusion is presented. It is concluded that the liquid wall reactor approach is attractive because it can handle large pellet yields, it minimizes blast and radiation damage, it allows high tritium breeding ratios, and power cycle efficiencies of 40 percent may be achievable.

55820 (ORNL/TM—6976) **Drag force on a conductive spherical drop in a nonuniform magnetic field.** Walker, J.; Wells, W.M. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

A high velocity lithium droplet cloud traversing the magnetic field of a fusion reactor may be useful for collecting plasma ions and their energy. In this report, the forces associated with such motion in nonuniform magnetic fields are derived.

55821 (UCRL—15033) **Research on the HYLIFE liquid-first-wall concept for future laser-fusion reactors. Final report No. 4, September 1977-March 1979.** Hoffman, M.A. (California Univ., Davis (USA). Dept. of Mechanical Engineering). Mar 1979. Contract W-7405-ENG-48. 39p. Dep. NTIS, PC A03/MF A01.

It has been proposed to protect the structural walls of a future laser fusion reactor with a curtain or wall of liquid lithium jets. As part of the investigation of this concept, experiments have been performed on planar sheet water jets issuing vertically downward from slit nozzles. The nozzles were subjected to forced harmonic excitation to simulate the vibrational environment of the laser fusion reactor, and experiments were run at both 1 atm and 0.2 atm pressure. Linear temporal stability theory is shown to predict the onset of the unstable regime and the spatial growth rates reasonably well for the cases where the amplitudes of the nozzle excitation are not too large and the waveform is nearly sinusoidal.

55822 (UCRL—81609) **Diagnostics considerations for the inertial confinement approach to controlled thermonuclear fusion power production.** Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Aug 1978. Contract W-7405-ENG-48. 17p. (CONF-7809168—1). Dep. NTIS, PC A02/MF A01.

From International school of plasma physics; Varenna, Italy (Sep 1978).

It is concluded that although the challenges facing diagnosticians working on the inertial confinement approach to controlled fusion are large and varied, the means potentially available to meet them are more than adequate. No new instrumentation fields need be opened; rather, substantial extensions of those already being explored by workers in ICF will suffice. Also, large contributions may be expected from other technological applications thrusts, as well as from the general, currently rapid advance of the entire physical technology base.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 55364, 55909

55823 (BNL—51008) **Studies of conductor joint performance and structural response for the DEALS magnet concept.** Powell, J.R.; Hsieh, S.Y.; Danby, G. (Brookhaven National Lab., Upton, NY (USA); Grumman Aerospace Corp., Bethpage, NY (USA)). Dec 1978. Contract EY-76-C-02-0016. 36p. Dep. NTIS, PC A03/MF A01.

The work carried out during a continuing limited study of parts of the DEALS concept (October 1977-March 1978) is described. The areas investigated included the design of joint configurations, analysis of out-of-plane forces on the joints and magnet system support structure, and the electrical and mechanical behavior of movable pressure-type joints. The basic assumptions and results for our recent DEALS studies are summarized together with recommendations for a future DEALS program. A description of two joint design options and the reasons for the design approaches are then discussed. The results of structural analysis are then given and the methods used in analyzing the loads and stresses in the structural support described. Finally, the results of preliminary electrical tests on small model joints with different surface materials under both static and dynamic conditions are presented and discussed.

55824 (CONF-790802—47) **Structural design of superconducting magnets for the large coil program.** Gray, W.H.; Long, C.J.; Stoddart, W.C.T. (Oak Ridge National Lab., TN (USA); Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1979. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The Large Coil Program is a research, development, and demonstration effort specifically for the advancement of the technologies involved in the production of large superconducting magnets. This paper presents a review of the status of the structural designs, analysis methods, and verification tests being performed by the

participating LCP design teams in the USA; Switzerland, Japan, and the Federal Republic of Germany. The significant structural mechanics concerns which are being investigated with the Large Coil Program are presented.

55825 (COO—2431-6) **Aspects of Tokamak toroidal magnet protection.** Green, R.W.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jul 1979. Contract EY-76-S-02-2431. 198p. Dep. NTIS, PC A09/MF A01.

Simple but conservative geometric models are used to estimate the potential for damage to a Tokamak reactor inner wall and blanket due to a toroidal magnet field collapse. The only potential hazard found to exist is due to the MHD pressure rise in a lithium blanket. A survey is made of proposed protection methods for superconducting toroidal magnets. It is found that the two general classifications of protection methods are thermal and electrical. Computer programs were developed which allow the toroidal magnet set to be modeled as a set of circular filaments. A simple thermal model of the conductor was used which allows heat transfer to the magnet structure and which includes the effect of temperature dependent properties. To be effective in large magnets an electrical protection system should remove at least 50% of the stored energy in the protection circuit assuming that all of the superconductor in the circuit quenches when the circuit is activated. A protection system design procedure based on this criterion was developed.

55826 (COO—5069-11) **Superbanana orbits in stellarator geometries.** Derr, J.A.; Shohet, J.L. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). Apr 1979. Contract ER-78-S-02-5069. 18p. Dep. NTIS, PC A02/MF A01.

The presence of superbanana orbit types localized to either the interior or the exterior of stellarators and torsatrons is numerically investigated for 3.5 MeV alpha particles. The absence of the interior superbanana in both geometries is found to be due to nonconservation of the action. Exterior superbananas are found in the stellarator only, as a consequence of the existence of closed helical magnetic wells. No superbananas of either type are found in the torsatron.

55827 (INIS-mf—4543, pp v) **Nonlinear analysis of a superconducting magnet of fusion reactor.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

In this paper, two constitutive models are proposed to represent the structural response of the superconducting magnet; viz., i) an orthotropic elastic-plastic model, and ii) a slip model for the layered media. The elastic-plastic behavior for each laminates is represented by the theory proposed by Hill, in which the material is assumed to be plastically incompressible and has equal yield strength in tension and compression. Then the elastic-plastic stress-strain flow for the laminated composite is derived by using a smearing process. In addition, an interlaminate slip model is established based on the considerations as follows. When the shear stresses at the interface between two laminate exceed the bonding strength tau_0 of the composite, slip will occur. Immediately after the slip is initiated, the interlaminate shear assumes a lower value tau/sub s/; where tau/sub s/ = $B tau_0$, $0 <= \beta <= 1$. The amount of stress loss is redistributed to the neighboring unslipped material by an equilibrium process. A slip criterion in terms of the interlaminar shear and the normal stress is used. Based on this criterion, an incremental stress-strain relationship for the slipped material element is derived from an assumption that the slip strains are proportional to the total interlaminar shear components. The stiffness matrix of the resulting stress-strain law is, however, not symmetric. For computational purposes, the stress-strain equations are written in two parts: a symmetric part to be used to form the tangent stiffness matrix, and the remaining part, treated as the initial strain.

55828 (LA-UR—79-1779) **Pitch programming of the ZT-S reversed-field pinch experiment.** Jacobson, A.; Burkhardt, L.C.; Baker, D.A.; Howell, R.B.; Schofield, A.E.; Sgro, A.G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-790912—5). Dep. NTIS, PC A02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

Pitch programming is only realizable in the non-ideal case and as such is tried on ZT-S. Once the resistivity profile in the plasma is determined along with the appropriate thermal conductivity, then q(t) at the wall possesses a fairly simple mapping to a q(r) for a given time as shown in the experimental results. Thus the resulting q(r) profiles are qualitatively similar to ones desirable from the point of MHD stability theory. The results of this initial investigation indicate that pitch programming should be pursued further as a possible means of setting up desirable equilibrium profiles in an RFP.

55829 (ORNL—5549, pp 119-138) **Superconducting magnet development.** Akin, J.E.; Alley, L. Jr.; Ballou, J.K. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The work of the Magnetics and Superconductivity (M and S) Section is divided into four areas: research and development activities (RDAC) in support of the Large Coil Program (LCP), advanced conductor development, the 12-T Coil Program, and magnet design projects. The primary emphasis during the past year has been the RDAC. Most of the facilities constructed have been for verification testing of superconductors in support of LCP subcontractors. Instrumentation, diagnostics, and protection have also made up a large part of the RDAC. Another area of work involving considerable interaction with subcontractors is coil fabrication technology.

55830 (UCRL—82850) **Thermal control for the MFTF magnet.** VanSant, J.H.; Russ, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jul 1979. Contract W-7405-ENG-48. 24p. (CONF-790815—7). Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

Four features of the thermal control plans for the Mirror Fusion Test Facility (MFTF) magnet are described. First, the proposed cooldown and warmup schedules for MFTF and the procedure for regenerating external cooling surfaces is outlined. Then the design of an external quench resistor, based on an estimate of the superconductor's maximum temperature, is discussed. A computer model of liquid helium circulation used to aid in choosing pipe for the LHe lines is explained.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 55859

HEATING AND FUELING SYSTEMS

55831 (GA-A—15232, pp 4.1-4.50) **Neutral beam program.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

The structure of the beam injection program for the Doublet-3 device is discussed. The design considerations for the beam line and design parameters for the Doublet-3 ion souce are given. Major components of the neutral beam injector system are discussed in detail. These include the neutralizer, magnetic shielding, reflecting magnets, vacuum system, calorimeter and beam dumps, and drift duct. The planned location of the two-injector system for Doublet-3 is illustrated and site preparation is considered. The status of beamline units 1 and 2 and the future program schedule are discussed.

55832 (ORNL—5549, pp 105-118) **Plasma heating and fueling.** Akins, J.E. (Univ. of Tennessee, Knoxville); Alsmiller, R.G. Jr.; Barber, G.C. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The Plasma Technology Section is principally concerned with (1) development of multimegawatt neutral beam lines, including electrical systems and vacuum pumping, for plasma heating and (2) development of techniques to fuel the plasma using high velocity pellets.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

55833 **Some safety aspects of tokamak-type fusion power reactors.** Ferrell, W.L. Los Angeles, CA; Univ. of California (1979). 138p. University Microfilms Order No. 79-15,658.

Thesis (Ph. D.).

In investigating the safety of Tokamak-type fusion reactors, two areas of concern are analyzed: firstly, the nonlinear behavior of the plasma under density-temperature instabilities; and secondly, an unprotected blanket loss-of-coolant-accident (LOCA). The plasma behavior is analyzed using a single species, point kinetics model; and the LOCA is analyzed using neutronic analysis, a magnetohydrodynamic (MHD) flow model, and a thermal hydraulic model. An analytical approach based on Comparison Methods is developed and is used to study the plasma.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 55377, 55378, 55379, 55381, 55421, 55422, 55423, 55424, 55425, 55426, 55427, 55428, 55429, 55430, 55431, 55644, 55645, 55654, 55655, 55656, 55657, 55658, 55659, 55822

55834 (ANL—79-41) **Proceedings of the heavy ion fusion workshop.** Arnold, R.C. (ed.). (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 440p. (CONF-780979—). Dep. NTIS, PC A19/MF A01.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

These proceedings contain reviews of current laboratory programs dealing with inertial fusion driven by beams of heavy ions, as

well as several individually abstracted invited talks, workshop reports and contributed papers.

55835 (ANL—79-41, pp 1-30) **Overview of the Argonne National Laboratory program.** Martin, R.L.; Burke, R.J.; Watson, J.M. (Argonne National Lab., IL). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The design activities and experimental R & D program of the heavy-ion fusion program at Argonne are discussed. A 1 MJ, 160 TW rf linac - accumulator system reference design is described, and a status report on the experimental program is given.

55836 (ANL—79-41, pp 57-59) **Lawrence Livermore Laboratory heavy ion fusion program.** Bangerter, R.O.; Lee, E.P.; Monsler, M.J.; Yu, S.S. (Lawrence Livermore Lab., CA). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Target design at LLL for heavy ion fusion power production is discussed, including target development and beam-target interaction. The energy conversion chamber design, which utilizes a liquid lithium blanket, is described. Ion beam transport theory is discussed.

55837 (ANL—79-41, pp 61-87) **Plan for the development and commercialization of inertial confinement fusion.** Willke, T. (Pacific Northwest Lab., Richland, WA); Dingee, D.; Ault, L.; Bampton, M.; Bickford, W.; Hartman, J.; Rockwood, A.; Simonen, E.; Teofilo, V.; Frank, T. 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

An engineering development program strategy to take inertial confinement fusion (ICF) from the milestone of scientific feasibility to a point where its commercial viability can be determined is described. The ICF program objectives and basic program strategy are discussed.

55838 (ANL—79-41, pp 89-92) **Focusing experiments with light ion diodes.** Johnson, D.L. (Sandia Labs., Albuquerque, NM). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

A review of recent experimental and theoretical work at Sandia Laboratories on magnetically insulated single stage ion diodes for inertial confinement fusion experiments is presented. The production, focusing, and numerical simulation of a 0.5 TW annular proton beam using the Proto I dual transmission line generator is described. The modular magnetically insulated ion diode for the Hydra generator is also described along with recent experimental results. A brief description of how an array of modular diodes similar to the Hydra magnetically insulated diode could be used on the EBFA I generator for breakeven fusion experiments is presented.

55839 (ANL—79-41, pp 101-110) **Diagnostics for pellet experiments.** Johnson, R.R. (KMS Fusion, Inc., Ann Arbor, MI). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The target diagnostics which are being used and planned in current laser driven ICF Experiments are described. Most of these diagnostics can be easily applied to future ion-beam fusion experiments. The status of laser fusion diagnostics has been much improved in the last 5 years and further improvements can be expected and should be available when the first ICF experiments using ion beams are performed. As an example, x-ray temporal and spatial resolutions are now approximately 5 psec and 3 μm, which is approximately a factor of 4 better than the resolution reported in the first implosion experiments. As one plans ahead for ion-beam fusion experiments it should be emphasized that high yield experiments are easier to diagnose provided adequate shielding is employed. However, in the event that the first high yield experiments fail it will be necessary to have diagnostics available to determine where the problems lie. In laser fusion it is interesting to note that higher laser powers are required now for breakeven experiments than first anticipated, mainly because some aspects of the laser-interaction physics were not recognized until the experiments were carefully diagnosed. Thus as has been pointed out, it may be necessary to increase the energy of the ion-beam driver to enable us to do breakeven experiments with high confidence.

55840 (ANL—79-41, pp 111-115) **Scaling laws for inertial confinement fusion.** Brueckner, K.A. (Univ. of California, San Diego). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

The fusion yield due to a spherically expanding burning front in a compressed fuel pellet is obtained. The pellet gain and beam energy for a laser system and an ion or electron beam driven system are compared. The results suggest an interesting possibility for heavy-ion fusion with driver parameters far below those usually considered.

55841 (ANL—79-41, pp 117-120) **Atomic and molecular physics.** Macek, J. (Univ. of Nebraska-Lincoln). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Collisions of fast ions with background gases and charge changing collisions of ions in accelerators and storage rings are discussed. Cross sections for well understood processes are summarized. The propagation of an ion beam to a target pellet through a gas filled reactor is considered.

55842 (ANL—79-41, pp 121-126) **Reference design cost analysis.** 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

Cost estimates for three heavy ion beam accelerator systems were obtained. The systems analyzed were (1) ANL Hearthfire 2, (2) LBL Induction Linac, and (3) BNL R.F. Linac with multiplier rings and accumulators. Costing ground rules were listed. Conclusions of the cost analysis were discussed.

55843 (ANL—79-41, pp 209-218) **Preliminary systems evaluation of heavy ion beam fusion drivers.** Kammash, T.; Drumm, C.R. (Univ. of Michigan, Ann Arbor). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

A systems analysis for a fusion reactor utilizing a heavy ion beam-pellet fusion is carried out to evaluate the performance of certain designs of potential drivers. As a reference case we have used the Argonne National Laboratory's Hearthfire Concept No. 3 which utilizes a rapid cycling synchrotron system. It is shown that such an accelerator can be an adequate driver if certain minimal requirements are met.

55844 (ANL—79-41, pp 219-223) **Elements to be considered in planning heavy ion fusion program: a summary.** Bohachevsky, I.O. (Los Alamos Scientific Lab., NM). 1978.

From Heavy ion fusion workshop; Chicago, IL, USA (19 Sep 1978).

A summary of Battelle's Engineering Development Program Plan for inertial confinement fusion is presented. Included are development objectives, facilities to achieve these objectives, program strategies, and a discussion of heavy-ion driver development.

55845 (CONF-790723—9) **Status of the Argonne National Laboratory heavy ion fusion program.** Martin, R.L.; Burke, R.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From 3. international topical conference on high power electron and ion beam research and technology; Novosibirsk, USSR (3 Jul 1979).

We have recently been successful with accelerating 50 mA of Xe^{+1} to 1.1 MeV in our modified Dynamitron in a pulse 100 μsec long. We anticipate conditioning the column to 1.5 MeV and bunching and accelerating the beam to 2 MeV in the first stages of the low velocity linac within the next few months. On the basis of the recommendations by a national committee reviewing inertial confinement fusion drivers, support for the heavy ion fusion program will be significantly increased in the next fiscal year with a view toward a choice between the two competing systems, rf linac with accumulator rings and induction linacs, in 1982 or 1983. Argonne has proposed a development program which will demonstrate by this time (at a relatively low current level) all the accelerator technology involved in the ignition source for a fusion power plant. The plan includes an interesting new concept of telescoping beams of different charge states with the same magnetic rigidity into the same beam line to reduce the number of beam lines otherwise required. The status and plans of the Argonne program will be reported.

55846 (COO—4080-5) **Development of improved laser glasses which can be melted on a commercial scale. Final report, September 15, 1976-September 30, 1978.** Vergano, P.J.; Rapp, C.F.; Huff, N.T.; Chapman, G.C. (Owens-Illinois Technical Center, Toledo, OH (USA)). May 1979. Contract EY-76-C-02-4080. 22p. Dep. NTIS, PC A02/MF A01.

This program was begun with the realization that fluorophosphate glass offered the possibiliy of low n_2 laser glass which would be suitable for use in the Lawrence Livermore NOVA system. The main objectives of the program were as follows: (1) the design of a fluorophosphate laser glass having the necessary properties for use in LLL's NOVA System; (2) the development of optimized processes for preparing fluorophosphate laser disks of the size needed for the NOVA System. Since September 30, 1977, the principal effort in the project has been directed toward the optimization of methods to prepare the fluorophosphate glass with the necessary optical, physical, and chemical properties. This report will review both the work prior to October 1, 1977 and the work following that date.

55847 (DOE/TIC—10212) **Laser fusion systems for industrial process heat. Third semiannual report.** Bates, F.J.; Denning, R.S.;

Dykhuizen, R.C.; Goldthwaite, W.H.; Kok, K.D.; Skelton, J.C. (Battelle Columbus Labs., OH (USA)). 31 Jan 1979. Contract W-7405-ENG-92-096. 66p. Dep. NTIS, PC A04/MF A01.

This report concentrates not only on the design of the laser fusion system but also on the cost of this system and the costs of alternative sources of energy that are expected to be in competition with the laser fusion system. The absolute values of the cost of the laser fusion system are limited by the estimates of the cost of the components and subsystems making up the laser fusion energy station. The method used in calculating costs of the laser fusion and alternative systems are laid out in detail.

55848 (IFVE-M—24(Pt.2), pp 423-430) **Prospects for ion beam fusion.** Martin, R.L. (Argonne National Lab., IL (USA)). 1977.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

The concept of using high-energy heavy ions for the ignition of pellets of thermonuclear materials is outlined. The Argonne development program including modifications of a 4MV dynamitron accelerator is presented. A low-beta accelerator which could accelerate a current of 50 mA of Xe^+ (averaged over the rf cycle including a bunching factor of three) from 750 kV to 1.6 MV has been designed. The linac structure consists of independent single drift tube cavities of 7 cm length in the beam direction separated by quadrupoles of 30 cm length. Several rf structures have been investigated to drive the drift tubes at a frequency of 12.5 MHz. It is concluded that the reliable operation of an intense heavy-ion source, a high-voltage dc accelerator, and the first stages of an rf linac should lead to a great deal of confidence that the concept of pellet fusion by high-energy heavy ions is indeed practical.

55849 (LA-UR—79-1835) **Target dynamics and thermonuclear burn, Part I.** Marshall, J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-790741—2). Dep. NTIS, PC A02/MF A01.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

The interaction between projectiles and targets in an impact fusion reactor system is considered. Heating by plane shock waves in DT is discussed. The condition for ignition is estimated and it is concluded that simple one-dimensional shock heating is unsuitable for fusion power production. It is suggested that shock heating followed by further compession would be an improvement.

55850 (LA-UR—79-1840) **Kaliski's explosive driven fusion experiments.** Marshall, J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-790741—6). Dep. NTIS, PC A02/MF A01.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

An experiment performed by a group in Poland on the production of DD fusion neutrons by purely explosive means is discussed. A method for multiplying shock velocities ordinarily available from high explosives by a factor of ten is described, and its application to DD fusion experiments is discussed.

55851 (LA-UR—79-1969) **Systems-design and energy-balance considerations for impact fusion.** Krakowski, R.A.; Miller, R.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract EY-7405-ENG-36. 25p. (CONF-790741—4). Dep. NTIS, PC A02/MF A01.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

Areas of concern and potential problems for impact fusion are qualitatively considered within an overall systems context. A parametric and qualitative description of the general energy balance and systems considerations for an Impact Fusion Reactor (IFR) design is discussed. Reactor systems design considerations for an IFR are presented. An attempt to assess the IFR viability is made based on highly simplified but limiting projectile-target energy balances and thermonuclear burn models. (SPH)

55852 (LA-UR—79-2059) **Single-point diamond-turned mirror performance before and after polishing.** Sollid, J.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790529—9). Dep. NTIS, PC A02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

The surface finish of a single-point diamond-turned (SPDT) mirror produced in 1977 on the large (2-meter swing) Excello lathe at the Union Carbide Corporation's Y-12 Plant in Oak Ridge, Tennessee, was such that it was not possible to do visible alignment using it. Therefore, it was necessary to polish the mirror by hand. This was done at the University of Arizona. The intent was to remove the high ridges in the SPDT mirror but not to degrade the figure. Both interferometric and encircled energy measurements were made on the mirror before and after polishing. The mirror was an f/2 off-axis parabola 39.37 cm in diameter. The equation describing the generator of the mother parabola is $y^2 = 309x(cm^2)$ and the center of each off-axis sister mirror is at $x = 7.64$ cm, and $y = 48.59$ cm. After polishing it was possible to align it using techniques which employed visible light.

55853 (LA-UR—79-2270) **Antares Power Amplifier optical system.** Silvernail, C.J.; Jones, K.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790529—11). Dep. NTIS, PC A02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

The optical systems of the six Antares Laser Power Amplifiers are described. These assemblies are preceded by the front-end optics and followed by the target system. Each power amplifier receives an annular input beam and divides it into 12 beams which are then directed to double pass them through 12 gain regions surrounding a central electron gun. Provisions are being made for spatially filtering each beam and for the possibility of adding saturable absorbers. Two keys to the successful completion of the power amplifier are: (1) the avoidance of unwanted lasing modes and hot spots in the wavefronts, and (2) the maintenance of alignment throughout the entire laser system, including the internal alignment of the Power Amplifier.

55854 (LA-UR—79-7178) **Review and status of Antares.** Jansen, J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790622—27). Dep. NTIS, PC A02/MF A01.

From Pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The laser fusion effort at the Los Alamos Scientific Laboratory (LASL) has evolved from early experiments with an electron-beam-controlled large-aperture CO_2 laser to the massive engineering task of designing and building a 100-kJ laser fusion machine. The design of Antares is based on the design of its predecessors. It builds upon technology which was developed or advanced during the design and construction of earlier machines. On one hand it is dictated by the requirements for the output, i.e., energy on target; on the other hand it is limited by existing technology or reasonable extensions thereof. Reliability and maintainability play important roles in the design considerations.

55855 (NVO—1559-1) **Fusion laser studies. Final report, 21 May 1978-21 November 1978.** Whittier, J.S.; Hough, J.J.T.; Wilkins, R.L.; Gross, R.W.F.; Hofland, R. Jr., Bott, J.F.; Cohen, N., Wang, C.P. (Aerospace Corp., Los Angeles, CA (USA). Aerophysics Lab.). Dec 1978. Contract ED-78-C-08-1559. 81p. Dep. NTIS, PC A05/MF A01.

Computer modeling of short-pulse HF chemical lasers is considered. At the outset of the work there was considerable disagreement between laser code predictions and short-pulse laser experiments. The disagreement was found to stem from spatially nonuniform reaction initiation in early experiments and from the code representations chosen for several important physical mechanisms. Upon the introduction of new treatments for initiation and energy loss mechanisms, and with the consideration of initiation nonuniformities, it was found that the plausible range of code predictions encompassed the experimental observations. Areas of work required to reduce the remaining modeling uncertainties are identified. Also included is an account of visits to Soviet laser fusion laboratories by two of the authors.

55856 (PNL—2803) **Factors affecting potential market penetration of laser fusion power plants.** Deonigi, D.E.; Fraley, D.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 47p. Dep. NTIS, PC A03/MF A01.

A mini-model has been constructed to estimate the optimal size of laser fusion power plants and to estimate the allowable cost of the first such plant in relation to the next best alternative. In estimating the costs of laser fusion, the mini-model incorporates such factors as market penetration, learning, economies of scale, system size, transmission costs, reserve requirements, development and licensing costs and site costs. The results of the mini-model simulations indicate that the optimal laser fusion plant size is approximately 3 GWe; risk considerations unincorporated in the mini-model suggest an optimal size closer to 2.5 GWe.

55857 (SAN—0115/130-1) **Jason: heavy-ion-driven inertial fusion.** Callan, C.G. Jr.; Dashen, R.F.; Garwin, R.L.; Muller, R.A.; Richter, B.; Rosenbluth, M.N. (SRI International, Arlington, VA (USA)). Feb 1978. Contract EY-76-C-03-0115-130. 20p. Dep. NTIS, PC A02/MF A01.

A few of the problems in heavy-ion-driven inertial-fusion systems are reviewed. Nothing was found within the scope of this study that would in principle bar such systems from delivering the energy and peak power required to ignite the fuel pellet. Indeed, ion-fusion seems to show great promise, but the conceptual design of ion-fusion systems is still in a primitive state. A great deal of work, mostly theoretical, remains to be done before proceeding with massive hardware development. Conclusions are given about the state of the work.

55858 (SAND—79-0496C) **Diagnostics program for a magnetically insulated ion diode for inertial confinement fusion.** Burns, E.J.T.; Johnson, D.J.; Farnsworth, A.V. Jr.; Fehl, D.L.; Leeper, R.J.; Mix, L.P.; Kuswa, G.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 4p. (CONF-790708—2). Dep. NTIS, PC A02/MF A01.

From XIV conference internationale sur les phenomenes d'ionisation dans les gaz; Grenoble, France (9 Jul 1979).

Some of the diagnostics used to study ion beam composition and profiles from magnetically insulated ion diodes, developed at Sandia Laboratories through the drift section to the target, are described. The carbon activation technique, which is used to measure proton and carbon fluence and flux, is discussed. Time resolved x-ray pinhole cameras, time resolved optical spectral measurements of the anode plasma, holographic interferometry and soft x-ray, vacuum ultraviolet spectroscopy are considered.

55859 (SAND—79-0949C) **Pulsed power systems for inertial confinement fusion.** VanDevender, J.P. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 6p. (CONF-791032—1). Dep. NTIS, PC A02/MF A01.

From Energy research session of the national electronics conference; Chicago, IL, USA (29 Oct 1979).

Sandis's Particle Beam Fusion Program is investigating pulsed electron and light ion beam accelerators with the goal of demonstrating the practical application of such drivers as igniters in inertial confinement fusion (ICF) reactors. The power and energy requirements for net energy gain are 10^{14} to 10^{15} W and 1 to 10 MJ. Recent advances in pulsed power and power flow technologies permit suitable accelerators to be built. The first accelerator of this new generation is PBFA I. It operates at 2 MV, 15 MA, 30 TW for 35 ns and is scheduled for completion in June 1980. The principles of this new accelerator technology and their application to ICF will be presented.

55860 (SAND—79-1411C) **Particle beam interactions with plasmas and their application to inertial fusion.** Clauser, M.J.; Burns, E.J.T.; Chang, J. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 16p. (CONF-790708—4). Dep. NTIS, PC A02/MF A01.

From XIV conference internationale sur les phenomenes d'ionisation dans les gaz; Grenoble, France (9 Jul 1979).

Some of the basic principles of fusion target implosions and the particle beam characteristics required to ignite the targets are summarized. The interaction of light ion beams and electron beams with fusion target plasmas is discussed. A brief historical review of the pulse-power approach to inertial fusion is given.

55861 (UCRL—81416(Rev.1)) **Mass spectrometer determination of argon contents in laser fusion target pellets.** Ward, C.M.; Bergquist, L.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Martin Marietta Corp., Denver, CO (USA)). 16 Apr 1979. Contract W-7405-ENG-48. 14p. (CONF-790125—78). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

A system for measuring argon contents in individual laser fusion targets using a getter pumped closed volume quadrupole mass spectrometer has been developed. Accuracy of 10% can be obtained, limited by the calibration standard and electron multiplier drift. Measurements are simple, unambiguous and can be performed at up to one per hour with a sensitivity equivalent to 1×10^3 Pa (.01 atm) argon in a 140 μm internal diameter sphere.

55862 (UCRL—82117) **Performance of Shiva as a laser fusion irradiation facility.** Speck, D.R.; Bliss, E.S.; Glaze, J.A.; Johnson, B.C.; Manes, K.R.; Ozarski, R.G.; Rupert, P.R.; Simmons, W.W.; Swift, C.D.; Thompson, C.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jun 1979. Contract W-7405-ENG-48. 31p. (CONF-7905113—1). Dep. NTIS, PC A03/MF A01.

From IEEE/OSA conference on laser engineering and applications; Washington, DC, USA (30 May 1979).

Shiva is a 20 beam Nd:Glass Laser and Target Irradiation Facility at the Lawrence Livermore Laboratory. The laser system and integrated target facility evolved during the last year from a large, untested, experimental laser system to a target irradiation facility which has provided significant laser driven inertial confinement fusion data. The operation of the facility is discussed.

55863 (UCRL—82429) **Laser-generated shockwave experiments at extreme high pressures.** Trainor, R.J.; Holmes, N.C.; More, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1979. Contract W-7405-ENG-48. 5p. (CONF-790709—13). Dep. NTIS, PC A02/MF A01.

From VII international AIRAPT conference; La Creusot, France (30 Jul 1979).

The application of high-power lasers to production of extreme high pressures is discussed. Shock velocities consistent with pressures up to 2 TPa in aluminum have already been measured, and experiments in the 4 TPa range are now planned. We describe the status of our programs to develop new diagnostic techniques and perform experiments to characterize perturbing influences on the shock.

55864 (UCRL—83022) **Analysis of long pulse physics experiments at LLL: Late 1977-Early 1979.** Rosen, M.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jul 1979. Contract W-7405-ENG-48. 37p. Dep. NTIS, PC A03/MF A01.

In the two years since the last Gordon Conference, we have shifted our interest in laser-plasma interactions to the long pulse (1 ns) regime on the Argus facility. A variable Z disk series (at 3×10^{14} W/cm^2) has been carried out and the Z dependence of line emission, backscatter, /sub h/ (hot electron temperature) and transport inhibition will be described. A variable thickness Au disk series that studied preheat and shocks will be analyzed. A simple theory for why T/sub h/ scales as Z/sup 1/4/ is presented, and a description of an electron transport experiment through layered disk targets is given.

55865 (UWFDM—220(Vol.1)) **SOLASE: a conceptual laser fusion reactor design.** Conn, R.W.; Abdel-Khalik, S.I.; Moses, G.A. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Dec 1977. Contract ES-77-S-02-4296. 586p. Dep. NTIS, PC A25/MF A01.

The SOLASE conceptual laser fusion reactor has been designed to elucidate the technological problems posed by inertial confinement fusion ractors. This report contains a detailed description of all aspects of the study including the physics of pellet implosion and burn, optics and target illumination, last mirror design, laser system analysis, cavity design, pellet fabrication and delivery, vacuum system requirements, blanket design, thermal hydraulics, tritium analysis, neutronics calculations, radiation effects, stress analysis, shield design, reactor and plant building layout, maintenance procedures, and power cycle design. The reactor is designed as a 1000 MW/sub e/ unit for central station electric power generation.

55866 (UWFDM—220(Vol.2)) **SOLASE: a conceptual laser fusion reactor design.** Conn, R.W.; Abdel-Khalik, S.I.; Moses, G.A. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Dec 1977. Contract ES-77-S-02-4296. 614p. Dep. NTIS, PC A99/MF A01.

The SOLASE conceptual laser fusion reactor has been designed to elucidate the technological problems posed by inertial confinement fusion reactors. This report contains a detailed description of all aspects of the study including the physics of pellet implosion and burn, optics and target illumination, last mirror design, laser system analysis, cavity design, pellet fabrication and delivery, vacuum system requirements, blanket design, thermal hydraulics, tritium analysis, neutronics calculations, radiation effects, stress analysis, shield design, reactor and plant building layout, maintenance procedures, and power cycle design. The reactor is designed as a 1000 MW/sub e/ unit for central station electric power generation.

55867 (Y/DA—8129) **LASL laser mirror program. Excerpts from Y-12 Development Division technical progress report, period ending December 1, 1978.** Thompson, C.H. (comp.). (Oak Ridge Y-12 Plant, TN (USA)). 24 Jul 1979. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

Development began on a center, diamond-turning process to fabricate flat mirrors for LASL's Antares experiment. One of the major sources of mirror figure error was found to be due to fixturing. Efforts were focused on minimizing the fixturing problems.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 55202, 55203, 55204, 55205, 55206, 55207, 55210, 55213, 55232, 55233, 55239, 55240, 55241, 55242, 55243, 55244, 55245, 55247, 55248, 55249, 55250, 55251, 55252, 55253, 55254, 55255, 55256, 55257, 55258, 55259, 55260, 55262, 55263, 55264, 55265, 55266, 55267, 55268, 55269, 55270, 55305, 55363

55868 (CONF-791103—20) **Neutron skyshine calculations for the PDX tokamak.** Wheeler, F.J.; Nigg, D.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Poloidal Divertor Experiment (PDX) at Princeton will be the first operating tokamak to require a substantial radiation shield. The PDX shielding includes a water-filled roof shield over the machine to reduce air scattering skyshine dose in the PDX control room and at the site boundary. During the design of this roof shield a unique method was developed to compute the neutron source emerging from the top of the roof shield for use in Monte

Carlo skyshine calculations. The method is based on simple, one-dimensional calculations rather than multidimensional calculations, resulting in considerable savings in computer time and input preparation effort. This method is described.

55869 (DOE/ET—0058/2) **Alloy development for irradiation performance. Quarterly progress report, January-March 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 183p. Dep. NTIS, PC A09/MF A01.

Separate abstracts were prepared for each of the included sections. (MOW)

55870 (DOE/ET—0058/2, pp 2-13) **Residual radioactivity of several commercial titanium alloys.** Davis, J.W.; Kulcinski, G.L.; Sung, T.Y. May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

The use of molybdenum, even in concentrations as low as 0.8 wt %, makes the long-term radioactivity in titanium comparable to the long-term radioactivity in type 316 stainless steel and therefore complicates the reprocessing of titanium alloys. Aluminum has much the same effect as molybdenum on the long-term radioactivity; however, the level of radioactivity is 10^3 times lower. Therefore aluminum-containing alloys could be reprocessed with modest shielding, but the aluminum content should be kept at 1 to 2 wt %. For strength and radioactivity, an attractive alloy composition could be titanium alloyed with 1 to 2 wt % Al, 10 to 14 wt % Sn, and 0.1 to 0.3 wt % Si.

55871 (DOE/ET—0058/2, pp 14-17) **Design of materials irradiation experiment for spectral tailoring.** Gabriel, T.A.; Allen, E.J.; Zulliger, A.F.; Woods, J.W.; Bloom, E.E. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

In alloys containing nickel the He/dpa production ratio of a fusion reactor can be reproduced within reasonable limits by continuous or stepwise modification of the thermal-to-fast neutron flux ratio. Neutronic calculations to determine the required change in spectrum as a function of time are described.

55872 (DOE/ET—0058/2, pp 20-35) **HFIR irradiation of hourglass fatigue specimens.** Grossbeck, M.L.; Kania, M.J. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

A capsule was designed for irradiation of hourglass fatigue specimens in HFIR. Three capsules have completed irradiation and two are undergoing irradiation. The capsule design and status of postirradiation disassembly of the first capsule are described.

55873 (DOE/ET—0058/2, pp 36-42) **Development of small fatigue-crack growth specimens for in-reactor and postirradiation testing.** James, L.A.; Bauer, R.E.; Straalsund, J.L. (Hanford Engineering Development Lab., Richland, WA). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Miniature fatigue-crack growth specimens have been developed. They will allow in-reactor and postirradiation tests to be conducted efficiently, minimizing both irradiation space and temperature differential (due to gamma heating) considerations. The results to date have indicated that this specimen design produces fatigue-crack growth rate data that are in excellent agreement with results for larger, nonwelded designs and is suited for both in-reactor and postirradiation testing.

55874 (DOE/ET—0058/2, pp 42-46) **Status of helium-preinjected annealed and 20%-cold-worked type 316 stainless steel irradiated in EBR-II at 500 and 625°C.** Maziasz, P.J.; Horak, J.A. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Tensile specimens of annealed and 20%-cold-worked type 316 stainless steel were preinjected with 80 and 200 at. ppM He and then irradiated in EBR-II at 500 and 625°C to fluences up to 2.3×10^{26} n/m^2 (> 0.1 MeV). Tensile property and microstructural response is being compared with samples in which the helium is produced continuously to evaluate helium preinjection and fast reactor irradiation as a simulation technique.

55875 (DOE/ET—0058/2, pp 47-53) **Influence of irradiation on the properties of path A alloy.** Wiffen, F.W.; Edmonds, D.P.; King, J.F. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Samples of 20%-cold-worked type 316 stainless steel containing a 16-8-2 weld were irradiated at 55°C to 4 to 11 dpa and 100 to 340 at. ppM He. For tensile tests at 300 and 700°C the ductility was reduced. At 300°C fractures occurred by transgranular shear and at 700°C by intergranular separation. All samples appear to have failed in the weld region.

55876 (DOE/ET—0058/2, pp 54-61) **Status of Fatigue Testing Facility.** Liu, K.C.; Grossbeck, M.L. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

A system for conducting fatigue tests on irradiated samples in a controlled environment (vacuum, inert gas, hydrogen, etc.) has been completed and tested outside the hot cell. The system is now being installed in the hot cell. Initial tests will be on type 316 stainless steel irradiated in HFIR.

55877 (DOE/ET—0058/2, pp 132-147) **Status of ORR-MFE-2.** Woods, J.W. (Oak Ridge National Lab., TN); Bloom, E.E.; Zulliger, A.F.; Greenwood, L.R. May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Redesign of ORR-MFE-2 to obtain more efficient heat removal has been completed. The experiment is being assembled and reactor insertion is projected to be about July 24. The flux and spectral mapping experiment is assembled and will be irradiated shortly before insertion of ORR-MFE-2.

55878 (DOE/ET—0058/2, pp 169-174) **Hydrogen permeation characteristics of Path A, Path B, and Path C alloys.** Deventer, E.H.; Maroni, V.A. (Argonne National Lab., IL). May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March 1978.

Hydrogen permeability of Inconel 718 was measured at temperatures in the range 100 to 800°C at hydrogen driving pressures from 10^{-1} to 10^4 Pa. Methods of preparing permeation assemblies for titanium-base alloys are being developed.

55879 (DOE/ET—0058/3) **Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 111p. Dep. NTIS, PC A06/MF A01.

Separate abstracts were prepared for 10 of the included sections.

55880 (DOE/ET—0058/3, pp 2-4) **Engineering properties for near term design and analysis.** Davis, J.W. (McDonnell Douglas Astronautics Co., St. Louis); Cramer, B.A.; Kummer, D.L.; Gold, R.E.; Smith, D.L.; Wiffen, F.W. May 1979.

In Alloy development for irradiation performance. Quarterly progress report, January-March, 1978.

Interim data needs to be established for candidate first wall/blanket structural materials to permit uniformity of near term design and structural analysis. During this quarter, procedures for establishing and disseminating the needed property values were examined and work was performed toward identifying the properties requiring immediate attention.

55881 (DOE/ET—0058/4) **Alloy development for irradiation performance. Quarterly progress report, January-March 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 141p. Dep. NTIS, PC A07/MF A01.

Separate abstracts were prepared for 12 of the included sections. (MOW)

55882 (DOE/ET—0058/4, pp 4-9) **Adaptation of an electrical potential technique to measure fatigue.** Straalsund, J.L.; Mervyn, D.A. (Hanford Engineering Development Lab., Richland, WA). May 1979.

In Alloy development for irradiation performance.

An adaptation of an electrical potential technique to measure crack growth on miniature center-cracked specimens has been shown to produce reliable, accurate results. Measurement of crack growth rate (da/dN) using this technique is at least as accurate as visual methods. As developed, the technique is conducive to high-volume postirradiation fatigue crack growth testing.

55883 (DOE/ET—0058/4, pp 10-17) **Design of materials irradiation experiments utilizing spectral tailoring.** Gabriel, T.A.; Thoms, K.R.; Woods, J.W. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

The effects of C-3 core piece composition and added fuel loaded around the C-3 position in the ORR are calculated. Adding 20 g fuel in each of the positions B-3, C-4, and D-3 reduces the thermal flux by about 4% and increases the dpa by about 6%. Additional calculations are contemplated for larger fuel loadings. A conceptual design of the experimental vehicle has been completed and the core pieces required for the first two stages of spectral tailoring are being fabricated. The composition of the experimental capsule differs from that used in the initial scoping calculations. As soon as final detailed information on the composition becomes available, the neutron flux and dpa will be recalculated. Calculations are in progress to obtain cross sections for neutron absorbers to be

used in the latter stages of spectral tailoring to reduce the thermal flux.

55884 (DOE/ET—0058/4, pp 18-21) **Status of fatigue testing facility.** Liu, K.C.; Grossbeck, M.L. (Oak Ridge National Lab., TN). May 1979.

In Alloy development for irradiation performance.

The fatigue testing system for in-cell testing has been completed and is currently being operated for testing irradiated specimens under cyclic fatigue loading. Excellent performance has been demonstrated for a few initial in-cell tests on two irradiated and two unirradiated 20%-cold-worked Type 316 stainless steel specimens at 430°C in high vacuum.

55885 (DOE/ET—0058/4, pp 128-132) **Hydrogen permeation characteristics of titanium-base alloys.** Van Deventer, E.H.; Maroni, V.A. (Argonne National Lab., IL). May 1979.

In Alloy development for irradiation performance.

The hydrogen permeation characteristics of the alloy Ti-6Al-4V have been evaluated. This alloy was found to have a permeability nearly 1000 times greater than that of conventional 300-series stainless steels. The dependence of the permeation rate on hydrogen pressure, P, was observed to vary over the range from $P^{0.4}$ to $P^{1.0}$. This result was construed as evidence for a permeation process that is at least partially influenced by surface impurity effects. The surface condition and mechanical integrity of the Ti-6Al-4V membrane appeared to be unaffected by ~ 1400 hours of hydrogen infiltration under typical power-reactor plasma-chamber conditions with respect to temperature, gas pressure, and gas composition. A nitride coating (applied by ion-implantation methods) on a second Ti-6Al-4V sample does not appear to have caused a significant reduction in the gross permeability observed for the initial sample.

55886 (DOE/ET—0065/6) **Damage analysis and fundamental studies. Quarterly progress report, April-June 1979.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). Jul 1979. 256p. Dep. NTIS, PC A12/MF A01.

Separate abstracts were prepared for 13 of the included sections. (MOW)

55887 (DOE/ET—0065/6, pp 13-20) **Dosimetry and damage analysis.** Greenwood, L.R. (Argonne National Lab., IL). Jul 1979.

In Damage analysis and fundamental studies.

Flux-spectral measurements in core position E7 of the Oak Ridge Research Reactor are summarized; the fraction of neutrons below 1 MeV is less than indicated by neutronic calculations. The analysis of ORR-MFE1 dosimetry is nearly completed.

55888 (GA-A—15232, pp 9.1-9.64) **Fusion development and technology.** Apr 1979.

In Magnetic Fusion Energy Program. Summary progress report, Fusion Division, October 1, 1977-September 30, 1978.

A discussion of particle and plasma interactions with surfaces is given. The reflux studies concerned with the sputtering of Cr ions from stainless steel by H_3 ions are presented. A surface analysis station for use on Doublet-3 is discussed. Details of the superconducting magnet program, including magnet system concepts for TNS (PGFR) and the superconducting high field test facility and General Atomic, are given. Systems studies for the fusion-fission fuel facility are presented.

55889 (INIS-mf—4543, pp v) **Plastic analysis and design of axisymmetric plates under thermal and mechanical loads.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The foregoing method is based on the lower bound theorem used for determining the collapse loads of axisymmetric plates subjected to rotationally symmetric loads and boundary conditions. It is assumed that the stresses and deformations have no effect on the temperature field. Based on this assumption the temperature distribution in the solid is determined independently. Further, for the range of temperatures considered it is assumed that the material remains almost homogeneous. The temperature distributions assumed are linear, parabolic and exponential over the thickness as well as along the radius of the plate. The thermal moment (M/sub t/) is then calculated which is subsequently converted into thermal loads. For an axisymmetric plate subjected to mechanical and thermal loads the equation of equilibrium may be written as (rM/sub r/)''-M'/sub theta/=-P/sub r/ where M/sub r/) and M/sub theta/ are, respectively, the radial and circumferential moments, r is any radius and P the combined thermal and mechanical loads. The collapse loads or the design moments can be calculated by using the continuity, boundary and the yield condition. The temperature distribution and the Tresca yield criterion are assumed to be time independent. Typical results have been obtained for a circular plate subjected to uniformly distributed and triangular loads. Thus the yield equality method can be effectively employed for limit analysis of axisymmetric plates subjected to thermal and mechanical loads.

55890 (LA-UR—79-969) **Preparation of fiber reinforced titanium diboride and boron carbide composite bodies.** Newkirk, L.R.; Riley, R.E.; Sheinberg, H.; Valencia, F.A.; Wallace, T.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-791017—3). Dep. NTIS, PC A02/MF A01.

From 7. international conference on chemical vapor deposition; Los Angeles, CA, USA (14 Oct 1979).

A process is described for uniformly infiltrating woven carbon cloth with either titanium diboride or boron carbide at reduced pressure (15 to 25 torr). The effects of deposition temperature on the uniformity of penetration and c coating rate are described for temperatures from 750 to 1000°C and deposit loadings from 20 to 43 vol. %. For the boron carbides, boron composition is discussed and evidence is presented suggesting that propene is the dominant rate controlling reactant.

55891 (NBSIR—79-1609) **Materials studies for magnetic fusion energy applications at low temperatures. II.** Fickett, F.R.; Reed, R.P. (eds.). (National Bureau of Standards, Boulder, CO (USA)). Jun 1979. Contract EA-77-A-01-6010-024. 526p. Dep. NTIS, PC A23/MF A01.

The work of the low temperature materials research project is summarized. Several individually abstracted reports of measurements of the low temperature mechanical and physical properties of stainless steel base metal and welds are included. Nitrogen strengthened steels, aluminium alloys, and industrial laminates were considered.

55892 (NBSIR—79-1609, pp 17-31) **Testing of 2219-T87 aluminum alloy at 4°K.** Shepic, J.A. (Martin Marietta Corp., Denver, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The tensile and fracture properties of heavy section (1.5 inches thick) 2219-T87 plate aluminum alloy at 4°K were determined. Transverse and longitudinal crack growth parameters were measured. Tensile specimens were taken at L, T, and ST orientations and tensile data is tabulated. K/sub Ic/ tests results and fatigue-crack growth data are summarized.

55893 (NBSIR—79-1609, pp 79-122) **Fracture and strength properties of selected austenitic stainless steels at cryogenic temperatures.** Read, D.T.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Fracture toughness, fatigue crack growth and tensile properties data for five austenitic stainless steels at 295, 76, and 4°K have been obtained to assess the suitability of these materials for load-bearing structures of large superconducting magnets. The steels were AISI 304, 316, 304LN, and 316LN, and an Fe-21Cr-12Ni-5Mn alloy with a higher nitrogen content. Tensile properties were measured at 4°K for two additional AISI 304L alloys with higher than usual nitrogen contents. At 4°K the yield strength ranged from 350 to 1330 MPa, a spread attributed to composition variations (especially nitrogen). A correspondingly large spread was observed in fracture toughness. Systematic variations of yield strength with nitrogen content and a systematic inverse correlation between fracture toughness and yield strength were observed.

55894 (NBSIR—79-1609, pp 123-147) **Heating and strain rate effects in AISI 304L stainless steel at 4°K.** Read, D.T.; Reed, R.P. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

Temperatures of small tensile specimens of AISI 304L stainless steel were measured during straining at 4°K at several strain rates and stress-strain curves were obtained at three strain rates. Serrated yielding was observed at all strain rates. The maximum temperature rise was calculated from the load drop, volume of specimen material heated and the physical properties of the specimen material. The calculated value agreed well with the measured value of 52°K.

55895 (NBSIR—79-1609, pp 149-172) **Low temperature deformation of Fe-18Cr-8Ni steel.** Read, D.T.; Reed, R.P.; Schramm, R.E. (National Bureau of Standards, Boulder, CO). Jun 1979.

In Materials studies for magnetic fusion energy applications at low temperatures. II.

The flow strengths of an Fe-18Cr-8Ni austenitic alloy were measured over the temperature range 4 to 300°K. This alloy did not transform martensitically on cooling but did transform to two martensitic products (body-centered-cubic, ferromagnetic and hexagonal-close-packed, non-ferromagnetic) during deformation. Volume percentages of the austenite and martensite phases formed and stacking and twin fault probabilities of the austenite were measured as functions of strain at 4°K using x-ray and magnetic techniques. Discussion is presented on the role of the martensitic transformation in affecting deformation of austenitic alloys.

55896 (ORNL—5549, pp 157-172) **Materials.** Bentley, J.; Bishop, B.L.; Bloom, E.E. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The materials work described in this report falls into three areas: (1) alloy development for irradiation performance, (2) damage analysis and fundamental studies, and (3) radiation effects on organic insulators for superconducting magnets. Alloy development activities, which constitute the major portion of the effort, are directed at four systems: (1) austenitic stainless steels; (2) higher strength Fe-Ni-Cr alloys; (3) reactive and refractory metals; and (4) innovative concepts, especially long-range-ordered (LRO) alloys.

55897 (ORNL—5549, pp 173-182) **Neutron transport.** Alsmiller, R.G. Jr.; Barish, J.; Barnes, J.M. Aug 1979.

In Fusion Energy Division annual progress report, period ending December 31, 1978.

The neutron transport program includes both experimental and analytic phases. The experimental program is designed to provide data necessary for verifying the analytic methods and cross-section data that are used at Oak Ridge National Laboratory (ORNL) and throughout the United States for fusion reactor neutronics design calculations. Experiments are being carried out to determine the neutron transport in typical fusion reactor shield materials and configurations and to determine the effects of penetrations in these shields. The analytic program is directed at providing support for the design of the integral experiments and comparing the calculated data with those obtained experimentally. Neutronics calculations have also been carried out in support of the design of the Tokamak Fusion Test Reactor (TFTR) being built at Princeton University and of fusion-fission hybrid reactor studies at ORNL.

55898 (ORNL—5561) **MAGIK: a Monte Carlo system for computing induced residual activation dose rates.** Barish, J.; Gabriel, T.A.; Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A04/MF A01.

The photon dose rate from the induced activity produced by sustained bombardment of materials by neutrons and charged particles may present a significant radiation hazard. To minimize this hazard, the material configuration must be so designed that the photon dose rate decays to an acceptable level soon after the source beam is turned off. MAGIK calculates the time-independent photon dose rates that result from activities produced by nucleon-nucleus and meson-nucleus collisions over a wide range of energies. The system has been used both for high-energy accelerator studies and for fusion reactor studies. In the MAGIK system the lengthy photon transport calculations are carried out independent of time, and the time dependence is introduced in the final program, thereby permitting study of various operating scenarios with a minimum computing cost.

55899 (ORNL/TM—6543) **Effects of Fe-Ni-Co-V structural alloys on fusion reactor neutronic performance.** Barnes, J.M.; Bishop, B.L.; Santoro, R.T.; Gabriel, T.A. (Oak Ridge National Lab., TN (USA)). Oct 1978. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

Calculations have been carried out to determine the effect of Fe-Ni-Co-V alloys on fusion reactor neutronic performance. The radiation damage in the first structural wall and the tritium breeding ratio were calculated as a function of alloy composition using the tritium breeding blanket module of the Experimental Power Reactor as the reference design. The atomic displacement rate was found to be approximately constant for all alloy combinations. However, the gas production and tritium breeding exhibit reasonably large variations (~ 20%) as the cobalt concentration is increased in the alloy.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 55031, 55904, 55907

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 55476, 55591, 55630, 55772

55900 (CONF-790825—3) **Limit theorem for the maximum term in an EARMA(1,1) sequence when the parameter rho is one.** Chernick, M.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Annual meeting of the American Statistical Association; Washington, DC, USA (12 Aug 1979).

The EARMA(1,1) process was defined by Jacobs and Lewis (Advances in Applied Probability, 1977). Chernick (Ph.D. dissertation, Stanford University, 1978) showed that the limit for the maximum term is the same as for a sequence of independent, identically distributed exponential random variables when the parameter rho is less than one. When rho equals one, a different limit theorem is obtained. The resulting limit distribution is not an extreme value type. It is, however, of the general form given by Galambos (The Asymptotic Theory of Extreme Order Statistics, Wiley, 1978). The sequence is exchangeable.

55901 (COO—2383-0058) **1979 SIGNUM meeting on numerical ordinary differential equations.** Skeel, R.D. (ed.). (Illinois Univ., Urbana (USA). Dept. of Computer Science). Apr 1979. Contract EY-76-S-02-2383. 128p. (UIUCDCS-R—79-963; UILU-ENG—79-1710; CONF-790403—). Dep. NTIS, PC A07/MF A01.

From SIGNUM meeting on numerical ordinary differential equations; Urbana, IL, USA (3 Apr 1979).

This report gives a summary of the papers presented at the meeting. It consists of all working papers distributed at the conference and all working papers received too late for distribution. In addition, abstracts and/or summaries are included where practical for those talks and workshop sessions that did not generate papers. This document should be a useful reference to very current research in ODEs. These papers are preliminary versions of papers that will be submitted for publication. One paper in this volume has been cited in ERA, and can be located by reference to the entry CONF-790403— in the Report Number Index.

55902 (COO—2874-54) **Estimation of random fields from network observations. Technical report No. 26.** Cabannes, A.F. (Stanford Univ., CA (USA). Dept. of Statistics). Jun 1979. Contract EY-76-S-02-2874. 128p. Dep. NTIS, PC A07/MF A01.

Thesis.

When one has observed a random field Z at some points and recorded its values (network observations), a natural problem is to estimate Z at points where there are no observations. This dissertation deals first with this problem in an abstract setting, in m dimensions; later, it considers the estimation of a spatial two-dimensional random field. The problem then is one of constructing an estimated map of Z over a geographic area. For a given network of stations the quality of a map depends on the method of estimation. But for the given method of estimation the quality of a map depends on the choice of locations for the stations. This is the problem of network design. Both the study of methods of estimation and the problem of network design are addressed. 16 figures. (RWR)

55903 (EGG—1183-5107) **Language for image processing (LIP).** Zander, M.E. (EG and G, Inc., Los Alamos, NM (USA)). 1979. Contract EY-76-C-07-1570. 6p. (CONF-791104—1). Dep. NTIS, PC A02/MF A01.

From 1. international micro and mini computer conference and exposition; Houston, TX, USA (14 Nov 1979).

A specialized language was created for arithmetic processing of digitized picture images from standard closed-circuit TV cameras. The language is essentially an array processor for 256 by 512 arrays stored as files under the RSX11M operating system. Advantage was taken of RSX11M tools such as the file system, command line input routine, the table-driven parser, and the indirect command line processor. 2 figures.

55904 (INIS-mf—4691, pp 181-204) **Data processing and systems analysis (DVSYS).** 1978. (In German).

In Progress report on research and development in 1977.

The annual report of the working group on data processing and systems analysis (DVSYS) describes the work done by the participating institutes of data processing in engineering reactor development, reactor operation technology, and the department of applied systems analysis (AFAS) in the three fields of process guidance, computer-aided design, and applied systems analysis.

55905 (LA—7499-M(Vol.3)) **Common File System primer.** (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

The Common File System (CFS) is a large, centralized data storage/retrieval system that provides permanent file space for worker computers in the Integrated Computer Network (ICN). This volume presents basic information on the use of CFS. Sections are entitled Getting started, Transmitting files, Querying CFS, Single-line execution of MASS, Watch your partition; and Sample MASS session. More details are available in the comprehensive CFS Reference Manual (PIM-5). (RWR)

55906 (LA-UR—79-1119) **Core + modules approach to Fortran standardization.** Brainerd, W.S. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791034—1). Dep. NTIS, PC A02/MF A01.

From American computing machinery conference; Detroit, MI, USA (29 Oct 1979).

In January 1978, ANSI X3J3 voted to adopt a framework consisting of a core and modules for developing the next revision of the ANSI Fortran standard. There are at least three reasons for adopting the core + modules approach: to provide a mechanism to interface with collateral standards and implementations in major applications areas; to provide a mechanism for having optional functional areas described within the standard; and to specify a smaller, more elegant language than Fortran 77 without decreasing the status of Fortran 77 as a standard language. Each of these reasons is discussed. Specific changes in Fortran are set down. The net effect of these changes is that: subroutine linkage facilities are enhanced to improve the interface with applications modules written in Fortran; archaic control structures are replaced with modern ones; the concept of storage association is removed; and fixed-form source is replaced with free-form source. (RWR)

55907 (LBL—9485) **Planning for future user services.** Franz, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 5p. (CONF-790921—1). Dep. NTIS, PC A02/MF A01.

From 7. ACM SIGUCC user services conference; Los Angeles, CA, USA (30 Sep 1979).

This paper explores the changes that will occur within User Services as the nature of computing changes and affects changes in institutions. In the past, most institutions have had one major computer center which supplied the bulk of the computer power and all related services and activities. Currently, there is a shift away from this concept. Computers are springing up all over. How this is affecting the computer centers and whether the computer center should continue to compete with these other centers or offer something else are matters demanding attention. A possible scenario is that the services and programming, including user services, will split off from the computer center and become a central unit within the institution, offering technical support for the central computer center and the satellites on an institution-wide basis. This paper examines the various ingredients affecting computing and tries to predict what the future might look like for User Service organizations.

55908 (ORNL/CSD—43) **Efficient procedure for selecting among five reliability models.** Kent, J.E.A. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 231p. Dep. NTIS, PC A11/MF A01.

Thesis. Submitted to North Carolina State Univ., Raleigh.

Several parametric families of probability distributions are commonly used to model reliability and life testing data. Efficient techniques are needed for the selection of the family of distributions which best describes a given set of experimental observations. A brief survey of methods used for discriminating among competing families of distributions is given. An efficient technique for selecting the best fitting family of distributions is derived. This technique uses scale-invariant statistics that minimize the probabilities of misclassification, and is extended beyond pairwise selections to selecting from a class of families of competing distributions. These statistics are not used in the hypothesis testing framework, but rather as measures of likelihood that the observed data have a distribution from a particular family of probability distributions. The class of families considered are the Uniform, Exponential, Gamma, Weibull, and Lognormal distributions, for the cases of shape parameters both known and unknown. Results of computer simulations are given for pairwise and multiple family selection procedures, showing the misclassification error rates achieved for selected sample sizes. Illustrations based on actual data are presented, along with a user program for convenient implementation of this procedure. 16 figures, 17 tables.

55909 (ORNL/TM—6918) **User and system considerations for the TCSTEK software library.** Gray, W.H. (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

This report documents the idiosyncrasies of the Tektronix PLOT 10 Terminal Control System level 3.3 software as it currently exists on the ORNL Fusion Energy Division DECsystem-10 computer. It is intended to serve as a reference for future Terminal Control System updates in order that continuity between releases of Terminal Control System PLOT 10 software may be maintained.

55910 (SAND—79-0483) **Comparison of nonlinear least squares software.** Hiebert, K.L. (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 46p. Dep. NTIS, PC A03/MF A01.

This report is the result of the comparison of twelve readily available FORTRAN codes (EO4GAF, EO4FAF, LMDER, LMDIF, ISQFDN, LSQFDQ, LSQNDN, NL2SOL, NSO3A, SNWT, TJMAR1, ZXSSQ) which solve unconstrained nonlinear least-squares problems. A set of 36 problems reported in the literature was used. To the extent possible, the parameters for the codes were set so as to have the codes solve equivalent problems. However, no code changes were made to achieve this goal. To test the robustness of the codes the initial starting value of the variables and the scaling of both the functions and the variables were varied. While measurements of efficiency such as the number of function evaluations and/or Jacobian evaluations and relative time were recorded, conclusions were based on the reliability of the codes. 6 figures, 7 tables.

55911 (SAND—79-8035) **Computerized art plotting system. Volume I. Horizontal bar charts.** Yano, H.; Daniel, J.; Dean, P. (Sandia Labs., Livermore, CA (USA)). Aug 1979. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

Instructions are given for creating horizontal bar charts using a CDC 6600 computer, Tektronix 4014 terminal, and a COBOL program based on the DISSPLA plotting package. The charts are of high quality and suitable for reports, journal articles, Vu-Graphs, and 35-mm slides. 7 figures.

55912 (SU—326-P30-65) **Computations related to G-stability of linear multistep methods.** LeVeque, R.; Dahlquist, G.; Andree, D. (Stanford Univ., CA (USA). Dept. of Computer Science; Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). May 1979. Contract EY-76-S-03-0326-030. 26p. Dep. NTIS, PC A03/MF A01.

In Dahlquist's recent proof of the equivalence of A-stability and G-stability [BIT 18, 384-401(1978)], an algorithm was presented for calculating a G-stability matrix for any A-stable linear multistep method. Such matrices, and various quantities computable from them, are useful in many aspects of the study of the stability of a given method. For example, information may be gained as to the shape of the stability region, or the rate of growth of unstable solutions. A summary of the relevant theory and the results of some numerical calculations performed for several backward differentiation, Adams-Bashforth, and Adams-Moulton methods of low order are presented in this work. 9 figures, 4 tables.

55913 (UCID—17526(Rev.1)) **MST-80B microcomputer trainer.** Jones, G.D.; Fisher, E.R.; Spann, J.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jun 1979. Contract W-7405-ENG-48. 40p. Dep. NTIS, PC A03/MF A01.

The microcomputer revolution in electronics is spreading so rapidly that it is difficult to educate enough people quickly and thoroughly in the new technology. Lawrence Livermore Laboratory's MST-80B was developed as a way to speed learning in in-house training courses, and it is now being widely used outside LLL. The MST-80B trainer is a complete, self-contained microcomputer system housed in a briefcase. The trainer uses the Intel 8080A 8-bit microprocessor (CPU), and it has its own solid-state memory, a built-in keyboard, and a display for input/output. The trainer is furnished with a permanent Monitor program (in read-only memory) that allows users to enter, debug, modify, and run programs of their own easily. 8 figures.

55914 (UCID—18200(Rev.1)) **CAMAC driver package.** Parrish, C.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Sep 1979. Contract W-7405-ENG-48. 37p. Dep. NTIS, PC A03/MF A01.

The CAMAC driver package operates on a HP 2100 or HP 21MX computer under RTE-II, RTE-III, or RTE-IV. The package consists of the following: a CAMAC driver (I/0 handler) (DVA54) (this is a system-resident routine allowing user program access to CAMAC compatible equipment); an interactive diagnostic program (CAM2) (this is an interactive program used for testing CAMAC equipment and the driver); an array initialization subroutine (FILL) (this subroutine will initialize an array to any desired value. All entries in the array will contain the same value. This subroutine is called by CAM2).

55915 (UCID—18276) **LLL-UHMLE: maximum likelihood estimates for the general normal mixture, preliminary user's guide.** Fritsch, F.N.; Walker, H.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

UHMLE is a FORTRAN program to compute maximum likelihood estimates for the parameters (means, covariances, proportions) in a mixture of M multivariate (N-dimensional) normal density functions, given a sample of observation vectors. 1 figure.

55916 (UCRL—52673) **Parametric characterization of random processes using Prony's method.** Smith, W.D.; Lager, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 May 1979. Contract W-7405-ENG-48. 77p. Dep. NTIS, PC A05/MF A01.

The compact parametric characterization of a random process is often valuable in problems involving signal classification and system identification. The method of Prony suggests two different approaches to obtaining such a characcterization from a finite record of sampled data. The first approach is to extract the parameters of the estimated autocorrelation waveform. The second approach is to estimate the parameters of a white-noise-driven linear system that generates an output with the same characteristics as the given random process. These two approaches are compared with other common signal processing methods. Also, the performance of each

approach is evaluated theoretically and with computer-simulated and experimentally recorded data. Each approach is found to characterize rapidly both stationary and nonstationary random processes. The first approach is superior for the accurate parametric characterization of a stationary process. Alternately, the more precise second approach is best for monitoring changes with time in random process parameters. 20 figures, 6 tables.

55917 (UCRL—83026) **Data flow computing: software development.** McGraw, .R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jul 1979. Contract W-7405-ENG-48. 12p. (CONF-791012—1). Dep. NTIS, PC A02/MF A01.

From Distributed computing systems conference; Huntsville, AL, USA (1 Oct 1979).

Data flow computing is one of the most radical approaches for multiprocessing. A computation is represented by its data flow graph and scheduling of each operator is done at run-time when all values of its operands are available. This paper addresses the problem of language design for a data flow environment. It briefly surveys several alternatives for a data flow language and then focuses on one specific effort: MIT VAL. This language stresses implicit concurrency. Both programer and translator can easily identify and exploit concurrency because VAL disallows all forms of side-effects and aliasing. The paper concludes with an analysis of the language and areas of continued research. While substantial progress has been made, much remains to be done in the areas of language design, translation, and use. 5 figures.

55918 (UCRL—83207) **Some programming aids for the DEC PDP-10.** McNamara, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Aug 1979. Contract W-7405-ENG-48. 16p. (CONF-791027—1). Dep. NTIS, PC A02/MF A01.

From Autumn college on plasma physics; Trieste, Italy (16 Oct 1979).

A simplified system has been written to help in FORTRAN programming of physics and mathematical problems. The system is described in Appendix A. A magnetic tape has been made of the complete system as used on the DEC-10 by M-Division for Magnetic Fusion related calculations. The system turns out to use many of the locally developed goodies, such as the TEDI text editor, the TV80 graphics system, and Tektronix 4012 videos. The facilities are briefly described in the HLP files on the tape.

55919 (UCRL—83291)* **Components of a network operating system.** Donnelley, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Sep 1979. Contract W-7405-ENG-48. 13p. (CONF-791023—3). Dep. NTIS, PC A02/MF A01.

From 4. local computer networks conference; Minneapolis, MN, USA (22 Oct 1979).

Recent advances in hardware interconnection techniques for local networks have highlighted the inadequacies in existing software interconnection technology. Although the idea of using a pure message passing operating system to improve this situation is not a new one, in the environment of a mature high-speed local network it is an idea whose time has come. A new timesharing system being developed at the Lawrence Livermore Laboratory is a pure message passing system. In this system, all services that are typically obtained directly by a system call (reading and writing files, terminal I/O, creating and controlling other processes, etc.) are instead obtained by communicating via messages with system service processes (which may be local or remote). The motivation for the development of this new system and some design and implementation features needed for its efficient operation are discussed. 4 figures.

55920 **Twentieth midwest symposium on circuits and systems.** Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977). 503p. (CONF-770891—P1).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

Eighty-five papers are presented in this volume on the following subjects: the routing problem; nonlinear system theory; digital fault analysis; microprocessor applications; digital system design; passive filters; bio-medical systems; two-dimensional digital filters; analog fault analysis; system theory; societal systems; active filters; network theory; integrated circuit simulators; advanced electronic device applications; matroids; power systems; multidimensional digital filters; and communication systems. Four of the papers are abstracted and indexed individually; the remaining ones are not in scope for the data base. (RWR)

55921 **Universal digital filter for use with 8-bit microprocessors.** Soderstrand, M.A. (Sandia Labs., Livermore, CA). pp 55-57 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

Microprocessors may be effectively used in digital filtering applications in real time through the use of a Residue Number Arithmetic-based Digital Filter Peripheral (DFP). This DFP is accessed through a single standard I/O instruction performing up to tenth order filtering at a sampling rate limited only by the rate at which the microprocessor can issue I/O instructions. Each I/O instruction causes the DFP to take one input sample from a previously specified input channel and provide one output sample to the I/O bus. The input sample may come from an A/D converter, a direct digital line, or a buffer previously filled by the microprocessor with an I/O instruction. The input to and output from the DFP will be in binary with any number of bits up to 16. The DFP will convert the binary to MOD 16, 15, 13, 11 residue for processing; thus, by modification of this conversion stage, 8-bit, 12-bit and 16-bit binary in ones-complement, two's-complement, or sign-magnitude may be accommodated. All calculations within the DFP itself, however, are done with RNS arithmetic with a 15-bit effective word size; stable, low-noise, digital filters result.

55922 **Finite order, recursive models for two-dimensional random fields.** Ekstrom, M.P.; Twogood, R.E. (Univ. of California, Livermore). pp 188-189 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

An algorithm is presented for the recursive modeling of two-dimensional random fields using an autoregressive, moving-average model. The model is developed by use of 2-D spectra factorization of the z transform of the covariance array, and nonlinear optimization techniques to ensure the finiteness of the factors. Numerical examples are presented.

55923 **Twentieth midwest symposium on circuits and systems.** Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977). 482p. (CONF-770891—P2).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

Eighty-eight papers are presented in this volume on the following subjects: system theory; large-scale systems; fault analysis; computer-aided design; control appliations; discrete transform techniques; detection and estimation; mathematical system theory; graph theory; control systems design; digital filters; and distributed and multivariable networks. Three of these papers are abstracted and indexed individually. One other paper has already been cited in ERA; it may be found by reference to the entry CONF-770891— in the Report Number Index. The remaining papers were not in scope for the data base. (RWR)

55924 **Tenth order digital filter using residue number arithmetic.** Soderstrand, M.A. (Sandia Labs., Livermore, CA); Fields, E.L. pp 899-903 of Twentieth midwest symposium on circuits and systems. Chao, K.S.; Saeks, R. (eds.). North Hollywood, CA; Western Periodicals Company (1977).

From 20. symposium on circuits and systems; Lubbock, TX, USA (15 Aug 1977).

An equivalent fifteen-bit, second-order digital filter operating at 8 MHz can be built using Residue Number System (RNS) arithmetic. Through time-sharing this section, an equivalent fifteen-bit, tenth-order filter can be operated at 1.6 MHz with typical bipolar programable read-only-memories (PROM), organized 256 x 4, the total cost of the tenth-order filter is around $500. 5 figures, 1 table.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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EY-76-C-03-0167-038	General Atomic Co., San Diego, CA (USA)	
	4:55809	GA-A—15232
EY-76-C-03-0167-052	General Atomic Co., San Diego, CA (USA)	
	4:54671	GA-A—15216
EY-76-C-03-0167-053	General Atomic Co., San Diego, CA (USA)	
	4:54203	GA-A—15374
	4:54205	GA-A—15452
EY-76-C-03-0511	Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy	
	4:55678	UH—511-346-79
EY-76-C-03-0515	Stanford Linear Accelerator Center, CA (USA)	
	4:55382	SLAC-PUB—2371
	4:55670	SLAC—216
EY-76-C-03-0700	Energy Technology Engineering Center, Canoga Park, CA (USA)	
	4:54694	ETEC-TDR—79-4
	4:54891	ETEC-TDR—78-19(Suppl.)
EY-76-C-03-0824	Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group	
	4:54693	ESG-DOE—13271
EY-76-C-03-0824-012	Rockwell International Corp., Canoga Park, CA (USA)	
	4:54741	SAN—0824-T1
	4:54742	SAN—0824-T2
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	4:54744	SAN—0824-T7
	4:54748	SAN—0824-T8
EY-76-C-03-0893	General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.	
	4:54707	GEFR-SP—140
	4:55225	GEFR-SP—164
EY-76-C-03-0893-030	General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.	
	4:54703	GEFR—00067-3
	4:54895	GEFR—00444
EY-76-C-03-0893-031	General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.	
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EY-76-C-03-0893-032	General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.	
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EY-76-C-03-1171	Department of Energy, San Francisco, CA (USA). San Francisco Operations Office	
	4:55168	SAN—1171-1
	4:55169	SAN—1171-3
	4:55170	SAN—1171-5

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EY-76-C-04-0053	**Monsanto Research Corp., Miamisburg, OH (USA)**	
	4:55325	MLM-MU—79-66-0004
EY-76-C-04-0487	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**	
	4:55467	MHSMP—79-33
EY-76-C-04-0656	**General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.**	
	4:54262	GEPP-TIS—432
EY-76-C-04-0789	**Sandia Labs., Albuquerque, NM (USA)**	
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	4:54233	SAND—79-1210C
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	4:54252	SAND—77-1936(Rev.)
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	4:54385	SAND—79-0379
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EY-76-C-05-5199	**West Virginia Geological and Economic Survey, Morgantown (USA)**	
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EY-76-C-06-1570	**Clemson Univ., SC (USA)**	
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EY-76-C-06-1830	**Sandia Labs., Albuquerque, NM (USA)**	
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	4:54575	TREE—1081(Rev.)
	4:54584	CONF-790906—24
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EY-76-C-08-1183	**EG and G, Inc., Las Vegas, NV (USA)**	
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	4:55607	DPSPU—79-30-8
EY-76-C-09-0001	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	4:55339	DP-MS—79-29
	4:55541	DP—1528
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EY-76-C-11-0014	Bettis Atomic Power Lab., West Mifflin, PA (USA)	
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EY-76-C-13-1664	Earth Sciences, Inc., Golden, CO (USA)	
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	4:54196	HEDL-TME—79-16
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	4:54708	HEDL-TME—79-24
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EY-76-C-15-2395	Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.	
	4:54692	CONF-791103—7(Summ)
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EY-76-S-02-1713	Washington Univ., St. Louis, MO (USA). Dept. of Chemistry	
	4:55338	COO—1713-84
EY-76-S-02-2195	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology	
	4:55475	COO—2195-32
EY-76-S-02-2218	Illinois Univ., Urbana (USA)	
	4:55775	COO—2218-133
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EY-76-S-02-2383	Illinois Univ., Urbana (USA). Dept. of Computer Science	
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EY-76-S-02-2387	Wisconsin Univ., Madison (USA)	
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EY-76-S-02-2401	Wayne State Univ., Detroit, MI (USA). Kresge Eye Inst.	
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EY-76-S-02-2431	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering	
	4:55825	COO—2431-6
EY-76-S-02-2456	Columbia Univ., New York (USA). Plasma Lab.	
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EY-76-S-02-2458	Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering	
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EY-76-S-02-2733	Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics	
	4:54757	COO—2733-22
EY-76-S-02-2793	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry	
	4:55321	COO—2793-15
EY-76-S-02-2853	Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy	
	4:55440	CONF-790610—4
EY-76-S-02-2874	Stanford Univ., CA (USA). Dept. of Statistics	
	4:55601	COO—2874-51
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EY-76-S-02-2983	Michigan Technological Univ., Houghton (USA)	
	4:54274	COO—2983-11
EY-76-S-02-2992	Michigan State Univ., East Lansing (USA). Div. of Engineering Research	
	4:54606	COO—2992-78/1(Exec.Summ.)
EY-76-S-02-3004	Stevens Inst. of Tech., Hoboken, NJ (USA)	
	4:55801	COO—3004-24
EY-76-S-02-3162	Cornell Univ., Ithaca, NY (USA)	
	4:55558	COO—3162-49
EY-76-S-02-3212	Roswell Park Memorial Inst., Buffalo, NY (USA)	
	4:55335	COO—3212-47
EY-76-S-02-3490	Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics	
	4:55562	UR—3490-1586
EY-76-S-02-4122	Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering	
	4:54758	COO—4122-27
EY-76-S-02-4178	Massachusetts Inst. of Tech., Cambridge (USA)	
	4:54376	COO—4178-2
EY-76-S-03-0034-233	California Univ., Riverside (USA)	
	4:55234	SAN—0034-233-T1
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EY-76-S-03-0034-243	California Univ., Santa Barbara (USA). Quantum Inst.	
	4:55344	SAN—0034/243-1
EY-76-S-03-0034-258	California Univ., Riverside (USA)	
	4:55235	SAN—0034-T4
EY-76-S-03-0326-030	Stanford Univ., CA (USA). Dept. of Computer Science	
	4:55912	SU—326-P30-65
EY-76-S-03-0511	Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy	
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EY-76-S-03-0899	Scripps Clinic and Research Foundation, La Jolla, CA (USA)	
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EY-76-S-05-3018	Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry	
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EY-76-S-05-3329	Duke Univ., Durham, NC (USA). Dept. of Pharmacology	
	4:55595	ORO—3329-13
EY-76-S-05-3628	North Carolina Univ., Chapel Hill (USA). Dept. of Bacteriology and Immunology	
	4:55570	ORO—3628-13
EY-76-S-05-3631	Duke Univ., Durham, NC (USA). Dept. of Zoology	
	4:55597	ORO—3631-9
EY-76-S-05-3861	Tennessee Univ., Knoxville (USA). Dept. of Physics	
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EY-76-S-05-3941	Duke Univ., Durham, NC (USA). Dept. of Biochemistry	
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EY-76-S-05-4063	North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering	
	4:55337	ORO—4063-T1
EY-76-S-05-4182	Howard Univ., Washington, DC (USA). Dept. of Botany	
	4:55560	ORO—4182-9
EY-76-S-05-4837	Oklahoma State Univ., Stillwater (USA). Dept. of Physics	
	4:55297	ORO—4837-6
EY-76-S-05-5134	Florida Univ., Gainesville (USA). Dept. of Electrical Engineering	
	4:54332	ORO—5134-1
EY-76-S-05-5198	Pennsylvania Dept. of Environmental Resources, Harrisburg (USA). Bureau of Topographic and Geologic Survey	
	4:54153	METC/EGSP—13
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	4:55599	DOE/EV/00637—8
EY-76-S-09-0890	Georgia Inst. of Tech., Atlanta (USA)	
	4:55540	SRO—0890-T2
EY-76-S-09-0893	Georgia Univ., Athens (USA). Dept. of Chemistry	
	4:54379	SRO—893-15
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EY-C-04-0789	**Sandia Labs., Albuquerque, NM (USA)**	
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FG05-79ET21068	**Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station**	
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NAS-7-100-95-4728	**Endurex Corp., Dallas, TX (USA)**	
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W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
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	4:54844	RDT-M—6-6T(7-79)(Rev.)
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	4:54502	114: 60-66(1977)
	4:54503	114: 67-94(1977)
CONF-770891-		(20. symposium on circuits and systems, Lubbock, TX, USA, 15-17 Aug 1977)
P1	4:55920	North Hollywood, CA; Western Periodicals Company (1977).
P2	4:55923	North Hollywood, CA; Western Periodicals Company (1977).
CONF-771078-		(Workshop on ISOL systems, Upton, NY, USA, 31 Oct-1 Nov 1977)
	4:54860	*See* BNL-50847
	4:55438	*See* BNL-50847
	4:55439	*See* BNL-50847

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	4:55685	*See* BNL-50847
	4:55714	*See* BNL-50847
	4:55716	*See* BNL-50847
	4:55717	*See* BNL-50847
	4:55720	*See* BNL-50847
	4:55721	*See* BNL-50847
	4:55722	*See* BNL-50847
	4:55723	*See* BNL-50847
	4:55724	*See* BNL-50847
	4:55725	*See* BNL-50847
	4:55726	*See* BNL-50847
CONF-7710184-	(IAEA specialists meeting on the effect of regulatory requirements on nuclear power plant control and instrumentation systems, Madrid, Spain, 4-6 Oct 1977)	
20	4:54849	*See* INIS-mf-4244
CONF-7710212-	(17. welding conference CSSR, Strbske Pleso, Czechoslovakia, 30 Oct-4 Nov 1977)	
	4:55189	*See* INIS-mf-4881
CONF-771120-	(Winter annual meeting of the American Society of Mechanical Engineers, Atlanta, GA, USA, 27 Nov-2 Dec 1977)	
P5	4:54450	New York, NY; American Society of Mechanical Engineers (1977).
P8	4:55150	New York, NY; American Society of Mechanical Engineers (1977).
CONF-7711123-	(KTG special meeting of the Fachgruppe Brennelemente, Bergisch Gladbach, F.R. Germany, 25 Nov 1977)	
	4:54679	*See* INTAT-78-70
	4:54851	*See* INTAT-78-70
	4:54852	*See* INTAT-78-70
	4:54853	*See* INTAT-78-70
	4:54854	*See* INTAT-78-70
	4:54855	*See* INTAT-78-70
	4:54981	*See* INTAT-78-70
CONF-7711125-	(2. conference on modular systems for data acquisition and processing, Prague, Czechoslovakia, 8-9 Nov 1977)	
	4:54850	*See* INIS-mf-4878
CONF-7711126-	(Symposium on reliability of power-generating facilities, Plzen, Czechoslovakia, 15-16 Nov 1977)	
	4:55020	*See* CS-INIS-225
CONF-780129-	(U.S. Fish and Wildlife Service workshop, Oak Ridge, TN, USA, Jan 1978)	
	4:55052	*See* ORAU-142
	4:55118	*See* ORAU-142
	4:55119	*See* ORAU-142
	4:55120	*See* ORAU-142
	4:55121	*See* ORAU-142
	4:55122	*See* ORAU-142
	4:55123	*See* ORAU-142
	4:55124	*See* ORAU-142
	4:55125	*See* ORAU-142
CONF-7804101-	(CCMS meeting, Dusseldorf, F.R. Germany, 19-20 Apr 1978)	
P2	4:54447	International Solar Energy Society, c/o VDI-GET, P.O. Box 1139, 4000 Duesseldorf, Germany
CONF-7805129-	(Solar grain drying conference, West Lafayette, IN, USA, 2-3 May 1978)	
	4:54451	Dep. NTIS, PC A08/MF A01
	4:54452	Dep. NTIS, PC A08/MF A01
	4:54453	Dep. NTIS, PC A08/MF A01
	4:54454	Dep. NTIS, PC A08/MF A01
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	4:55592	Dep. NTIS, PC A08/MF A01
CONF-7805178-	(Conference on reactor materials science, Alushta, Ukrainian SSR, 29 May-1 Jun 1978)	
P1	4:54198	*See* INIS-mf-4905
P1	4:54199	*See* INIS-mf-4905
P1	4:54677	*See* INIS-mf-4905
P1	4:54865	*See* INIS-mf-4905
P1	4:55190	*See* INIS-mf-4905
P1	4:55198	*See* INIS-mf-4905
P1	4:55226	*See* INIS-mf-4905
P1	4:55279	*See* INIS-mf-4905
P1	4:55280	*See* INIS-mf-4905
P1	4:55281	*See* INIS-mf-4905
P1	4:55282	*See* INIS-mf-4905
P1	4:55283	*See* INIS-mf-4905
P1	4:55284	*See* INIS-mf-4905
P1	4:55285	*See* INIS-mf-4905
P1	4:55286	*See* INIS-mf-4905
P1	4:55287	*See* INIS-mf-4905
P1	4:55288	*See* INIS-mf-4905
P1	4:55303	*See* INIS-mf-4905
P1	4:55312	*See* INIS-mf-4905
P1	4:55754	*See* INIS-mf-4905
P2	4:54197	*See* INIS-mf-4903
P2	4:55271	*See* INIS-mf-4903
P2	4:55272	*See* INIS-mf-4903
P2	4:55273	*See* INIS-mf-4903
P2	4:55274	*See* INIS-mf-4903
P2	4:55275	*See* INIS-mf-4903
P2	4:55276	*See* INIS-mf-4903
P2	4:55277	*See* INIS-mf-4903
P2	4:55278	*See* INIS-mf-4903
P2	4:55311	*See* INIS-mf-4903
CONF-780631-	(12. conference on trace substances, Columbia, MO, USA, 5-8 Jun 1978)	
	4:55635	Columbia, MO; University of Missouri (1978).
CONF-780644-	(3. conference on clustering aspects of nuclear structure and nuclear reactions, Winnipeg, Canada, 19-23 Jun 1978)	
	4:55693	No. 47, 652-653(1978)
	4:55696	No. 47, 508-509(1978)
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	4:55701	No. 47, 598-599(1978)
	4:55702	No. 47, 628-629(1978)
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	4:55704	No. 47, 680-681(1978)
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	4:55708	No. 47, 640-641(1978)
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	4:55711	No. 47, 726-727(1978)
	4:55713	No. 47, 716-717(1978)
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	4:55738	No. 47, 402-414(1978)
	4:55751	No. 47, 114-131(1978)
	4:55752	No. 47, 308-325(1978)
	4:55753	New York, NY; American Inst. of Physics (1978).
CONF-7806154-	(Los Alamos Scientific Laboratory summer school on nuclear science, Los Alamos, NM, USA, Jun 1978)	
	4:55740	*See* LA-7852-C
	4:55742	*See* LA-7852-C
	4:55743	*See* LA-7852-C
	4:55749	*See* LA-7852-C
CONF-7806159-	(American Scientific Glass Blowers Society symposium, San Jose, CA, USA, 19-22 Jun 1978)	
1	4:54258	*See* UCRL-80949
CONF-7806165-	(Hydride storage reservoir symposium, Upton, NY, USA, 20-21 Jun 1978)	
	4:54269	*See* BNL-26523
CONF-780756-	(Conference on industrial application of magnetic separation, Rindge, NH, USA, 30 Jul-4 Aug 1978)	
	4:55353	New York, NY; Institute of Electrical and Electronic Engineers, Inc. (1979).
CONF-780903-	(Symposium on potential health and environmental effects of synthetic fossil fuel technologies, Gatlinburg, TN, USA, 25-28 Sep 1978)	
	4:54021	Dep. NTIS, PC A13/MF A01
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	4:54045	Dep. NTIS, PC A13/MF A01
	4:54059	Dep. NTIS, PC A13/MF A01
	4:54065	Dep. NTIS, PC A13/MF A01
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	4:54100	Dep. NTIS, PC A13/MF A01

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	4:54182	Dep. NTIS, PC A13/MF A01
CONF-780926-	(3. symposium on neutron capture of gamma-ray spectroscopy, Upton, NY, USA, 18 Sep 1978)	
25	4:55453	*See* BNL-25540
CONF-780979-	(Heavy ion fusion workshop, Chicago, IL, USA, 19-26 Sep 1978)	
	4:55421	*See* ANL-79-41
	4:55422	*See* ANL-79-41
	4:55423	*See* ANL-79-41
	4:55424	*See* ANL-79-41
	4:55425	*See* ANL-79-41
	4:55426	*See* ANL-79-41
	4:55427	*See* ANL-79-41
	4:55428	*See* ANL-79-41
	4:55429	*See* ANL-79-41
	4:55430	*See* ANL-79-41
	4:55431	*See* ANL-79-41
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	4:55645	*See* ANL-79-41
	4:55654	*See* ANL-79-41
	4:55655	*See* ANL-79-41
	4:55656	*See* ANL-79-41
	4:55657	*See* ANL-79-41
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	4:55659	*See* ANL-79-41
	4:55834	*See* ANL-79-41
	4:55835	*See* ANL-79-41
	4:55836	*See* ANL-79-41
	4:55837	*See* ANL-79-41
	4:55838	*See* ANL-79-41
	4:55839	*See* ANL-79-41
	4:55840	*See* ANL-79-41
	4:55841	*See* ANL-79-41
	4:55842	*See* ANL-79-41
	4:55843	*See* ANL-79-41
	4:55844	*See* ANL-79-41
CONF-7809168-	(International school of plasma physics, Varenna, Italy, Sep 1978)	
1	4:55822	*See* UCRL-81609
CONF-781007-	(IAEA symposium on nuclear material safeguards, Vienna, Austria, 2-6 Oct 1978)	
P1	4:54255	*See* STI/PUB-497(Vol.1)
CONF-781094-	(Mt Hood interactive planning workshop, Gresham, OR, USA, 15-17 Oct 1978)	
P2(Summ.)	4:55085	Dep. NTIS, PC A03/MF A01
CONF-7810130-	(The molten carbonate fuel cell workshop, Oak Ridge, TN, USA, 31 Oct-3 Nov 1978)	
4	4:55148	Dep. NTIS, PC A02/MF A01
CONF-7810153-	(Conference on fire particulate emmissions form fluid bed and conventional combustions, Washington, DC, USA, 23-24 Oct 1978)	
	4:54096	Dep. NTIS, PC A06/MF A01
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	4:54103	Dep. NTIS, PC A06/MF A01
	4:54104	Dep. NTIS, PC A06/MF A01
CONF-7810185-	(Transmission static VAR systems seminar, Duluth, NM, USA, 24 Oct 1978)	
	4:54623	*See* EPRI-EL-1047-SR
	4:54630	*See* EPRI-EL-1047-SR
	4:54631	*See* EPRI-EL-1047-SR
	4:54632	*See* EPRI-EL-1047-SR
	4:54633	*See* EPRI-EL-1047-SR
	4:54634	*See* EPRI-EL-1047-SR
	4:54635	*See* EPRI-EL-1047-SR
	4:54636	*See* EPRI-EL-1047-SR
	4:54637	*See* EPRI-EL-1047-SR
CONF-7810208-	(Actinide environmental research workshop, Airlie, VA, USA, 10-12 Oct 1978)	
1	4:55340	*See* RHO-SA-84
CONF-781109-	(Environmental control symposium, Washington, DC, USA, 28-30 Nov 1978)	
30	4:54568	Dep. NTIS, PC A02/MF A01
CONF-781147-	(6. meeting of the projekt nukleare sicherheit, Karlsruhe, F.R. Germany, 28-29 Nov 1978)	
6	4:54979	*See* INKA-Conf-78-078-006
7	4:54980	*See* INKA-Conf-78-078-007
8	4:54978	*See* INKA-Conf-78-078-005
9	4:54977	*See* INKA-Conf-78-078-003
10	4:54976	*See* INKA-Conf-78-078-002
CONF-781159-	(Fall DECUS U.S. symposium, San Francisco, CA, USA, 27-30 Nov 1978)	
8	4:55460	*See* UCRL-81871
CONF-781191-	(DOE photovoltaics technology development and applications program review conference, Arlington, VA, USA, 7-9 Nov 1978)	
	4:54295	Dep. NTIS, PC A23/MF A01
CONF-7811138-	(64. scientific assembly and annual meeting of the Radiological Society of North America, Chicago, IL, USA, 25 Nov-1 Dec 1978)	
1	4:55588	Dep. NTIS, PC A03/MF A01
CONF-781222-	(4. workshop on geothermal reservoir engineering, Stanford, CA, USA, 13-15 Dec 1978)	
5	4:54511	*See* LBL-9330
CONF-781250-	(Science underlying waste management conference, Boston, MA, USA, 1 Dec 1978)	
2	4:54243	*See* RHO-SA-87
CONF-790107-	(3. national conference and exhibition on technology for energy conservation, Tucson, AZ, USA, 22-26 Jan 1979)	
11	4:54293	*See* SERI/TP-51-188
CONF-790120-	(2. annual conference on absorber surfaces for solar receivers, Boulder, CO, USA, 24-25 Jan 1979)	
2(Rev.)	4:54478	*See* LBL-8632(Rev.)
CONF-790125-	(1. topical meeting on fusion reactor materials, Miami Beach, FL, USA, 29-31 Jan 1979)	
78	4:55861	*See* UCRL-81416(Rev.1)
CONF-790239-	(Specialists' meeting on decay heat removal and natural convection in FBRs, Upton, Long Island, NY, USA, 28-29 Feb 1979)	
1	4:54689	Dep. NTIS, PC A03/MF A01
CONF-790323-	(Symposium on high spin phenomena in nuclei, Argonne, IL, USA, 15-17 Mar 1979)	
6	4:55733	*See* LBL-9570
CONF-790384-	(GCFR safety specialist meeting (NEA/IAEA), Brussels, Belgium, 13-15 Mar 1979)	
3	4:54698	*See* GA-A-15462
CONF-790403-	(SIGNUM meeting on numerical ordinary differential equations, Urbana, IL, USA, 3-5 Apr 1979)	
	4:55901	*See* COO-2383-0058
CONF-790415-	(177. national meeting of the American Chemical Society, Honolulu, HI, USA, 1-6 Apr 1979)	
40	4:55483	*See* COO-1199-56
CONF-790423-	(2. multiphase flow and heat transfer symposium workshop, Miami Beach, FL, USA, 16-18 Apr 1979)	
16	4:54861	Dep. NTIS, PC A02/MF A01
CONF-790457-	(1979 photovaltaic solar energy conference, West Berlin, F.R. Germany, 23-26 Apr 1979)	
8	4:54326	*See* DOE/ET/23103-5
CONF-790479-	(National conference on hazardous material risk assessment, disposal, and management, Miami Beach, FL, USA, 25-27 Apr 1979)	
1	4:55637	Dep. NTIS, PC A02/MF A01
CONF-790487-	(NATO advanced study Institute on ordering in strongly - fluctuating condensed - matter systems, Geilo, Norway, 16-27 Apr 1979)	
3	4:55759	*See* BNL-25944
CONF-7904101-	(IMOG machine tool subgroup meeting, Los Alamos, NM, USA, 10-11 Apr 1979)	
1	4:55345	*See* LA-UR-79-1826
CONF-7904109-	(EPA/ORNL synfuel meeting, Triangle Park, NC, USA, 26 Apr 1979)	
1	4:55618	*See* UCRL-83185
CONF-790515-	(International assembly on energy storage, Dubrovnik, Yugoslavia, 27 May-1 Jun 1979)	
1	4:54378	*See* SAND-79-0736C
4	4:55023	*See* COO-4094-48
CONF-790524-	(6. international congress symposium on radiation research and stem cells, Tokyo, Japan, 13-19 May 1979)	
10	4:55604	Dep. NTIS, PC A02/MF A01
CONF-790529-	(Conference on Optics, Los Alamos, NM, USA, 23-25 May 1979)	
9	4:55852	*See* LA-UR-79-2059
11	4:55853	*See* LA-UR-79-2270
CONF-790538-	(Fast ion transport in solids-electrode and electrolytes conference, Lake Geneva, WI, USA, 21-25 May 1979)	
16	4:55028	Dep. NTIS, PC A02/MF A01
17	4:55299	Dep. NTIS, PC A02/MF A01
18	4:55320	Dep. NTIS, PC A02/MF A01
CONF-790541-	(International Solar Energy Society meeting, Atlanta, GA, USA, 28 May 1979)	
44	4:54327	*See* DOE/ET/23103-6
47	4:54322	*See* COO-4094-45
48	4:54323	*See* COO-4094-49

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CONF-790572-	(Helium Breeder Associates/US Dept of Energy GCFR technical meeting, San Diego, CA, USA, 30 May-1 Jun 1979)	
4	4:54697	*See* GA-A-15444
6	4:54701	*See* GA-A-15515
7	4:54699	*See* GA-A-15511
8	4:54698	*See* GA-A-15462
CONF-790573-	(12. University of Rochester symposium on environmental toxicity: polluted rain, Rochester, NY, USA, 21-23 May 1979)	
3	4:55481	Dep. NTIS, PC A02/MF A01
CONF-7905103-	(Energy technology conference on waste irradiation, Hanover, F.R. Germany, 2-4 May 1979)	
1	4:55177	*See* SAND-79-1538C
CONF-7905105-	(Conference on using land to save energy, Chicago, IL, USA, 18-19 May 1979)	
1	4:55063	*See* COO-4531-5
CONF-7905108-	(Atmospheric tracer workshop, Los Alamos, NM, USA, 23-24 May 1979)	
1	4:55482	Dep. NTIS, PC A02/MF A01
CONF-7905113-	(IEEE/OSA conference on laser engineering and applications, Washington, DC, USA, 30 May-1 Jun 1979)	
1	4:55862	*See* UCRL-82117
CONF-7905114-	(Structural pathology in DNA and the biology of aging, Freiburg, F.R. Germany, 13-19 May 1979)	
1	4:55575	Dep. NTIS, PC A02/MF A01
CONF-790601-	(Photovoltarc material and device measurement workshop, Arlington, VA, USA, 11-13 Jun 1979)	
	4:54334	*See* SERI/TP-49-185
	4:54335	*See* SERI/TP-49-185
	4:54336	*See* SERI/TP-49-185
	4:54337	*See* SERI/TP-49-185
	4:54338	*See* SERI/TP-49-185
	4:54339	*See* SERI/TP-49-185
	4:54340	*See* SERI/TP-49-185
	4:54341	*See* SERI/TP-49-185
	4:54342	*See* SERI/TP-49-185
	4:54343	*See* SERI/TP-49-185
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	4:54359	*See* SERI/TP-49-185
	4:54360	*See* SERI/TP-49-185
	4:54361	*See* SERI/TP-49-185
	4:54362	*See* SERI/TP-49-185
	4:54363	*See* SERI/TP-49-185
	4:54364	*See* SERI/TP-49-185
	4:54365	*See* SERI/TP-49-185
CONF-790602-	(ANS annual meeting, Atlanta, GA, USA, 3-8 Jun 1979)	
85	4:54203	*See* GA-A-15374
CONF-790610-	(International conference on nuclear physics with electromagnetic interactions, Mainz, F.R. Germany, 5-9 Jun 1979)	
4	4:55440	Dep. NTIS, PC A02/MF A01
CONF-790615-	(3. US national congress on pressure vessels and piping, San Francisco, CA, USA, 25-29 Jun 1979)	
26	4:55390	Dep. NTIS, PC A03/MF A01
27	4:55346	Dep. NTIS, PC A02/MF A01
CONF-790622-	(Pulsed power conference, Lubbock, TX, USA, 12-14 Jun 1979)	
27	4:55854	*See* LA-UR-79-7178
CONF-790632-	(JOWOG-28, Albuquerque, NM, USA, 11-14 Jun 1979)	
8	4:55308	*See* UCRL-82627
CONF-790634-	(72. annual Air Pollution Control Association meeting, Cincinnati, OH, USA, 24-28 Jun 1979)	
3	4:55507	Dep. NTIS, PC A02/MF A01
4	4:55162	*See* LBL-8894
CONF-790637-	(Symposium on accuracy in power diffraction, Washington, DC, USA, 11-15 Jun 1979)	
1(Rev.1)	4:55758	*See* UCRL-82268(Rev.1)
2	4:55295	*See* BNL-26502
CONF-790640-	(18. symposium on engineering aspects of magnetohydrodynamics, Butte, MT, USA, 18-20 Jun 1979)	
2	4:54095	Dep. NTIS, PC A02/MF A01
5	4:55139	Dep. NTIS, PC A02/MF A01
CONF-790641-	(Rare earth research conference, Fargo, ND, USA, 25-28 Jun 1979)	
2	4:55323	*See* MLM-2617(OP)
CONF-790642-	(International conference on high energy physics, Geneva, Switzerland, 27 Jun-4 Jul 1979)	
4	4:55669	*See* LBL-9502
CONF-790651-	(National conference on synchrotron radiation instrumentation, Gaithersburg, MD, USA, 4-6 Jun 1979)	
6	4:55456	*See* BNL-26586
CONF-790653-	(Superconductivity in d- and f-band metals, San Diego, CA, USA, 21-23 Jun 1979)	
14	4:55766	*See* BNL-26542
CONF-790657-	(Conference on irradiation behavior of metallic materials for fast reactor core components, Corsica, France, 5-8 Jun 1979)	
5	4:55246	Dep. NTIS, PC A02/MF A01
CONF-790666-	(34. Northwest regional meeting of the American Chemical Society, Richland, WA, USA, 13-15 Jun 1979)	
4	4:54214	*See* RHO-SA-110
5	4:55324	*See* RHO-SA-113
CONF-790676-	(Conference on DNA repair and mutagenesis in bacteria, Atlanta, GA, USA, 25-28 Jun 1979)	
6	4:55596	Dep. NTIS, PC A02/MF A01
CONF-790678-	(ASHRAE society meeting, Detroit, MI, USA, 24-28 Jun 1979)	
2	4:55152	*See* LBL-8835
CONF-790690-	(4. international conference on laser spectroscopy, Rottach-Egern, Tegernsee, F.R. Germany, 11-15 Jun 1979)	
3	4:55660	Dep. NTIS, PC A04/MF A01
CONF-7906103-	(International conference on martensitic transformation, Boston, MA, USA, 24-29 Jun 1979)	
1	4:55200	*See* LBL-9346
3	4:55196	Dep. NTIS, PC A02/MF A01
CONF-7906104-	(Wastewater workshop, Germantown, MD, USA, 14-15 Jun 1979)	
1	4:54069	*See* LA-UR-79-1919
CONF-7906107-	(American Society of Limnolgy and Oceanography conference, Stony Brook, NY, USA, 19 Jun 1979)	
1	4:55616	*See* DP-MS-79-8
CONF-7906117-	(1. international symposium on policy analysis and information systems, Durham, NC, USA, 28-30 Jun 1979)	
1	4:55041	Dep. NTIS, PC A02/MF A01
CONF-7906120-	(7. annual industrial pollution conference, Philadelphia, PA, USA, 5-7 Jun 1979)	
1	4:54148	Dep. NTIS, PC A02/MF A01
CONF-7906121-	(Permiability and groundwater containment transport symposium, Philadelphia, PA, USA, 17-23 Jun 1979)	
1	4:55638	Dep. NTIS, PC A03/MF A01
CONF-7906122-	(Mini-conference on microwave modeling of laser plasma interactions, Redondo Beach, CA, USA, 27 Jun 1979)	
1	4:55805	*See* LA-UR-79-2394
CONF-7906124-	(Diffusion chamber culture workshop, Upton, NY, USA, 25-26 Jun 1979)	
1	4:55567	*See* BNL-26544
CONF-790706-	(1979 IEEE Annual conference on nuclear and space radiation effects, Santa Cruz, CA, USA, 17-20 Jul 1979)	
6	4:55455	*See* SAND-79-1273C
CONF-790707-	(20. annual meeting of the Institute of Nuclear Materials Management, Albuquerque, NM, USA, 16-19 Jul 1979)	
16	4:54247	Dep. NTIS, PC A02/MF A01
20	4:54253	*See* SAND-79-1111C
21	4:54254	*See* SAND-79-1397C
29	4:54251	*See* RHO-SA-96

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31	4:54250	*See* RFP-2913
CONF-790708-	(XIV conference internationale sur les phenomenes d'ionisation dans les gaz, Grenoble, France, 9-13 Jul 1979)	
2	4:55858	*See* SAND-79-0496C
4	4:55860	*See* SAND-79-1411C
CONF-790709-	(VII international AIRAPT conference, La Creusot, France, 30 Jul-3 Aug 1979)	
13	4:55863	*See* UCRL-82429
CONF-790718-	(American Agricultural Economics Association meeting, Pullman, WA, USA, 29 Jul-1 Aug 1979)	
2	4:55593	*See* LA-UR-79-2018
CONF-790720-	(4. international congress LASER 79 opto-electronics, Munich, F.R. Germany, 2-6 Jul 1979)	
3	4:55321	*See* COO-2793-15
CONF-790723-	(3. international topical conference on high power electron and ion beam research and technology, Novosibirsk, USSR, 3-6 Jul 1979)	
9	4:55845	Dep. NTIS, PC A02/MF A01
CONF-790728-	(24. annual meeting of the Health Physics Society, Philadelphia, PA, USA, 7-13 Jul 1979)	
2	4:55607	*See* DPSPU-79-30-8
4	4:55760	Dept. NTIS, PC A02/MF A01
CONF-790737-	(Mitigation symposium, Ft Collins, CO, USA, 17-19 Jul 1979)	
3	4:55555	Dep. NTIS, PC A02/MF A01
CONF-790741-	(DOE impact fusion workshop, Los Alamos, NM, USA, 10-13 Jul 1979)	
2	4:55849	*See* LA-UR-79-1835
4	4:55851	*See* LA-UR-79-1969
5	4:55819	*See* BNL-26494
6	4:55850	*See* LA-UR-79-1840
CONF-790747-	(Coal modeling conference, Bozeman, MT, USA, 25-26 Jul 1979)	
2	4:54098	Dep. NTIS, PC A02/MF A01
CONF-790757-	(ARPA/AF review of progress in quantitative NDE, La Jolla, CA, USA, 8-13 Jul 1979)	
1	4:55399	*See* LA-UR-79-1902
2	4:55400	*See* SAND-79-1217C
CONF-790763-	(4. international conference on behavioral travel modeling, Eibsee, F.R. Germany, 2-6 Jul 1979)	
1	4:55166	Dep. NTIS, PC A03/MF A01
CONF-790802-	(International conference on structural mechanics in reactor technology, Berlin, F.R. Germany, 13-17 Aug 1979)	
42	4:54026	Dep. NTIS, PC A02/MF A01
43	4:54756	Dep. NTIS, PC A02/MF A01
47	4:55824	Dep. NTIS, PC A02/MF A01
69	4:54690	Dep. NTIS, PC A02/MF A01
70	4:54877	Dep. NTIS, PC A02/MF A01
CONF-790803-	(14. intersociety energy conversion conference, Boston, MA, USA, 5-10 Aug 1979)	
40	4:54320	*See* COO-4094-42
41	4:54321	*See* COO-4094-43
43	4:54394	Dep. NTIS, PC A02/MF A01
44	4:54567	Dep. NTIS, PC A02/MF A01
46	4:54042	*See* UCRL-81934
49	4:55029	Dep. NTIS, PC A02/MF A01
50	4:54281	Dep. NTIS, PC A02/MF A01
CONF-790808-	(18. ASME national heat transfer conference, San Diego, CA, USA, Aug 1979)	
17	4:54386	*See* SERI/TP-34-169
CONF-790815-	(Cryogenic engineering conference, Madison, WI, USA, 21-24 Aug 1979)	
6	4:55364	*See* UCRL-82397
7	4:55830	*See* UCRL-82850
8	4:55224	*See* BNL-26450
17	4:55768	*See* LA-UR-79-2135
18	4:55444	*See* BNL-26567
CONF-790816-	(International meeting on fast reactor safety technology, Seattle, WA, USA, 19-23 Aug 1979)	
26	4:55015	*See* SAND-79-1685C
27	4:55014	*See* SAND-79-1602C
33	4:55010	*See* SAND-79-0123C
34	4:55004	*See* SAND-79-0079C
35	4:55011	*See* SAND-79-0126C
36	4:55006	*See* SAND-79-0082C
37	4:54878	Dep. NTIS, PC A02/MF A01
38	4:54986	*See* LA-UR-79-2340
39	4:54691	Dep. NTIS, PC A02/MF A01
40	4:55007	*See* SAND-79-0091C
41	4:54983	*See* LA-UR-79-2141
42	4:55003	*See* SAND-79-0057C
44	4:54984	*See* LA-UR-79-2245
45	4:55008	*See* SAND-79-0107C
46	4:55016	*See* SAND-79-1708C
47	4:55009	*See* SAND-79-0112C
48	4:54874	*See* BNL-NUREG-26572
49	4:54848	*See* LA-UR-79-2128
50	4:55012	*See* SAND-79-0140C
51	4:55013	*See* SAND-79-0798C
52(Summ.)	4:55005	*See* SAND-79-0081C
53	4:54868	*See* SAND-79-1646C
CONF-790819-	(Topical meeting on photoacoustic spectroscopy, Ames, IA, USA, 1-3 Aug 1979)	
6	4:55315	Dep. NTIS, PC A02/MF A01
CONF-790822-	(87. AICHE national meeting, Boston, MA, USA, 19 Aug 1979)	
10	4:54074	Chicago, IL; Institute of Gas Technology (1979).
CONF-790825-	(Annual meeting of the American Statistical Association, Washington, DC, USA, 12-16 Aug 1979)	
3	4:55900	Dep. NTIS, PC A02/MF A01
CONF-790842-	(International conference of global atmospheric pollution, Boulder, CO, USA, 22 Aug 1979)	
1	4:55493	*See* UCRL-82028
CONF-790843-	(8. international conference on atomic collisions in solids, Hamilton, Canada, 13-17 Aug 1979)	
2	4:55756	*See* SAND-79-0486C
5	4:55661	Dep. NTIS, PC A02/MF A01
7	4:55647	*See* SAND-79-1764C
CONF-790846-	(American Institute of Biological Science conference, Stillwater, OK, USA, 13 Aug 1979)	
1	4:55617	*See* DP-MS-79-17
CONF-790847-	(International conference on high energy physics and nuclear structure, Vancouver, Canada, 13-17 Aug 1979)	
3	4:55692	Dep. NTIS, PC A02/MF A01
4	4:55707	Dep. NTIS, PC A02/MF A01
5	4:55442	*See* LA-UR-79-2137
CONF-790850-	(1. international symposium on non-conventional energy, Trieste, Italy, 27 Aug-7 Sep 1979)	
1	4:54482	*See* SAND-79-1378C
2	4:54443	*See* SAND-79-1574C
CONF-790851-	(8. international conference on amorphous and liquid semiconductors, Cambridge, MA, USA, 27-31 Aug 1979)	
1	4:55763	*See* SAND-79-0812C
2	4:55764	*See* SAND-79-0823C
3	4:55309	*See* BNL-26646
CONF-790853-	(ONR workshop on electron generators of coherent radiation, Telluride, CO, USA, 13-17 Aug 1979)	
1	4:55382	*See* SLAC-PUB-2371
CONF-790854-	(Mechanical and mag. energy storage contractor, Washington, DC, USA, 19-22 Aug 1979)	
1	4:55021	*See* SAND-79-1642C
2	4:55024	*See* UCRL-83043
CONF-790855-	(Symposium on instrumentation and control for fossil energy processes, Denver, CO, USA, 20-22 Aug 1979)	
1	4:54051	*See* SAND-79-1216C
2	4:54101	Dep. NTIS, PC A02/MF A01
CONF-790858-	(4. international symposium on environmental biogeochemistry, Canberra, Australia, 27 Aug-5 Sep 1979)	
2	4:55494	*See* UCRL-82556
CONF-790859-	(International conference on liquid scintillation counting--recent applications and development, San Francisco, CA, USA, 21-24 Aug 1979)	
1	4:55313	Dep. NTIS, PC A02/MF A01
CONF-790861-	(11. international conference on the physics of electronic and atomic collisions, Kyoto, Japan, 29 Aug-4 Sep 1979)	
5	4:55662	Dep. NTIS, PC A02/MF A01

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CONF-790862-		(3. international conference on phonon scattering in condensed matter, Providence, RI, USA, 28-31 Aug 1979)
1	4:55761	*See* LA-UR-79-2324
CONF-790865-		(ANS/ENS international meeting on fast reactor safety technology, Vancouver, Canada, 19-23 Aug 1979)
1	4:54985	*See* LA-UR-79-2285
CONF-790868-		(IEEE ultrasonics symposium, New Orleans, LA, USA, Aug 1979)
1	4:55225	*See* GEFR-SP-164
CONF-790869-		(8. annual conference of the International Society for Experimental Hematology, Rotterdam, Netherlands, 21-24 Aug 1979)
1	4:55568	*See* BNL-26620
CONF-790901-		(15. international congress on refrigeration, Venice, Italy, 23-29 Sep 1979)
3	4:54270	*See* LA-UR-79-583
4	4:55348	*See* LA-UR-79-662
CONF-790905-		(American Society for Quality Control conference, Las Vegas, NV, USA, 24-26 Sep 1979)
2	4:54871	*See* UNI-SA-61
CONF-790906-		(Geothermal Resources Council annual meeting, Reno, NV, USA, 24 Sep 1979)
24	4:54584	Dep. NTIS, PC A02/MF A01
26	4:54569	Dep. NTIS, PC A02/MF A01
27	4:54585	Dep. NTIS, PC A02/MF A01
28	4:54512	*See* LBL-9458
CONF-790909-		(International conference on magnetism, Munich, F.R. Germany, Sep 1979)
4	4:55199	*See* LA-UR-79-2261
CONF-790912-		(9. European conference on controlled fusion and plasma physics, Oxford, UK, 17-21 Sep 1979)
2	4:55783	*See* SAND-79-1481C
4	4:55798	*See* UCRL-82349
5	4:55828	*See* LA-UR-79-1779
CONF-790913-		(54. annual technical conference and exhibition, Las Vegas, NV, USA, 23-26 Sep 1979)
1	4:54161	*See* SAND-79-0582C
7	4:54159	*See* UCRL-82456
8	4:54582	*See* LBL-9606
CONF-790916-		(Annual IES technical conference, Atlantic City, NJ, USA, 15 Sep 1979)
2	4:55153	*See* LBL-9048
CONF-790917-		(American Chemical Society national meeting, Washington, DC, USA, 10-14 Sep 1979)
2	4:55307	*See* UCRL-82488
3	4:55306	*See* SAND-78-1866C
4	4:54027	Dep. NTIS, PC A02/MF A01
5	4:55339	*See* DP-MS-79-29
6	4:54055	*See* BNL-26210
7	4:54050	*See* SAND-79-0738C
CONF-790919-		(14. European congress on molecular spectroscopy, Frankfurt, F.R. Germany, 3-7 Sep 1979)
1	4:55326	*See* COO-4695-2
CONF-790920-		(Annual meeting of the Society of Petroleum Engineers, Las Vegas, NV, USA, 23-27 Sep 1979)
1	4:54581	*See* LBL-9303
CONF-790921-		(7. ACM SIGUCC user services conference, Los Angeles, CA, USA, 30 Sep-3 Oct 1979)
1	4:55907	*See* LBL-9485
CONF-790923-		(Decontamination and decommissioning of nuclear facilities conference, Sun Valley, ID, USA, 16-19 Sep 1979)
1	4:54873	*See* UNI-SA-63
2	4:55341	*See* UCRL-82381
3(Summ.)	4:54862	Dep. NTIS, PC A02/MF A01
CONF-790927-		(Linear accelerator conference, Montauk, NY, USA, 10-14 Sep 1979)
1	4:55436	*See* LA-UR-79-2419
CONF-790929-		(18. IEEE Computer Society international conference, Washington, DC, USA, 4-7 Sep 1979)
1	4:54834	*See* LA-UR-79-978
CONF-790930-		(Conference on polarized neutron in condensed matter research, Zaborow, Poland, 10-12 Sep 1979)
1	4:55227	*See* IS-M-188
CONF-790931-		(14. international symposium on advances in chromatography, Lausanne, Switzerland, 24-28 Sep 1979)
1	4:54180	*See* LA-UR-79-1147
2	4:55317	*See* IS-M-187
CONF-790932-		(7. National Science Foundation grantee's conference on production research and technology, Ithaca, NY, USA, 25-27 Sep 1979)
1	4:55350	*See* UCRL-83200
CONF-790933-		(IAEA international symposium on fast reactor physics, Aix-en-Provence, France, 24-28 Sep 1979)
1	4:54688	*See* BNL-25598
CONF-790936-		(Electrical overstress/electrostatis discharge symposium, Denver, CO, USA, 25-27 Sep 1979)
1	4:55300	*See* SAND-79-1715C
CONF-790937-		(Heat and mass transfer seminar on heat and mass transfer in metallurgical systems, Dubrovnik, Yugoslavia, 3-7 Sep 1979)
1	4:55191	*See* LBL-8519
CONF-790938-		(Workshop on the use of argillaceous materials for the isolation of radioactive wastes, Paris, France, 10-12 Sep 1979)
1	4:54235	*See* SAND-79-1475C
2	4:54234	*See* SAND-79-1430C
CONF-790940-		(International conference on mossbauer spectroscopy, Portoroz, Yugoslavia, 10-14 Sep 1979)
1	4:55767	*See* LA-UR-79-1789
CONF-790941-		(MTS Oceans conference, San Diego, CA, USA, Sep 1979)
1	4:54419	*See* LBL-9183
CONF-790942-		(Hydrogen in air transportation conference, Stuttgart, F.R. Germany, 10-14 Sep 1979)
1	4:54271	*See* LA-UR-79-1416
CONF-790943-		(12. summer school in nuclear physics, Mikoajki, Poland, 2-14 Sep 1979)
1	4:55750	*See* UCRL-83247
CONF-791005-		(ISA national conference, Chicago, IL, USA, 22-25 Oct 1979)
2	4:54389	*See* SAND-79-1532C
4	4:54388	*See* SAND-79-1295C
5	4:54468	*See* SERI/TP-39-240
CONF-791007-		(Energy systems analysis international conference, Dublin, Ireland, 9-11 Oct 1979)
3	4:55033	*See* BNL-26390
CONF-791011-		(Marine Technology Society conference, New Orleans, LA, USA, 10-12 Oct 1979)
1	4:54420	*See* LBL-9495
CONF-791012-		(Distributed computing systems conference, Huntsville, AL, USA, 1-4 Oct 1979)
1	4:55917	*See* UCRL-83026
CONF-791013-		(26. national vacuum symposium, New York, NY, USA, 2-5 Oct 1979)
1	4:55765	*See* SAND-79-1150C
3	4:55445	*See* BNL-26591
CONF-791017-		(7. international conference on chemical vapor deposition, Los Angeles, CA, USA, 14-19 Oct 1979)
3	4:55890	*See* LA-UR-79-969
4	4:55294	*See* SAND-79-0097C
5	4:55304	*See* LA-UR-79-951
7	4:55322	*See* LMSC/D-672696
CONF-791021-		(2. American Electroplaters Society symposium on coatings for solar collectors, St Louis, MO, USA, 16-17 Oct 1979)
1	4:54479	*See* LBL-9324
CONF-791022-		(4. national passive solar energy conference, Kansas City, KS, USA, 3-5 Oct 1979)
1	4:54437	*See* LA-UR-79-2382
2	4:54436	*See* LA-UR-79-2381
CONF-791023-		(4. local computer networks conference, Minneapolis, MN, USA, 22-23 Oct 1979)
3	4:55919	*See* UCRL-83291
CONF-791026-		(Cell biology conference, Toronto, Canada, Oct 1979)
1	4:55594	*See* DOE/EV/01071-1
CONF-791027-		(Autumn college on plasma physics, Trieste, Italy, 16 Oct-23 Nov 1979)
1	4:55918	*See* UCRL-83207
CONF-791028-		(Conference on electrical insulation and dielectric phenomena, Whitehaven, PA, USA, 21-25 Oct 1979)
1	4:55762	*See* SAND-79-0581C

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3	4:55643	*See* SAND-79-0598C
CONF-791029-	(Project management institute seminar symposium, Atlanta, GA, USA, 18-20 Oct 1979)	
1	4:55031	*See* BNL-26179
CONF-791032-	(Energy research session of the national electronics conference, Chicago, IL, USA, 29-31 Oct 1979)	
1	4:55859	*See* SAND-79-0949C
CONF-791034-	(American computing machinery conference, Detroit, MI, USA, 29-31 Oct 1979)	
1	4:55906	*See* LA-UR-79-1119
CONF-791038-	(4. conference on numerical weather prediction, Silver Spring, MD, USA, 29 Oct-1 Nov 1979)	
1	4:55476	*See* UCRL-82548
CONF-791040-	(2. computers in aerospace conference, Los Angeles, CA, USA, 22-24 Oct 1979)	
1	4:55405	*See* SAND-79-0714C
CONF-791101-	(9. world conference on nondestructive testing, Melbourne, Australia, 18-23 Nov 1979)	
3	4:55401	*See* UCRL-81030
CONF-791103-	(American Nuclear Society meeting, San Francisco, CA, USA, 12-16 Nov 1979)	
1	4:54242	*See* RFP-2967
2	4:55539	*See* LBL-9277
3(Summ)	4:54755	*See* COO-2458-25
4(Summ)	4:54879	Dep. NTIS, PC A02/MF A01
5	4:54241	Dep. NTIS, PC A02/MF A01
6	4:54880	Dep. NTIS, PC A02/MF A01
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10(Summ.)	4:54233	*See* SAND-79-1210C
11	4:55452	*See* SAND-79-1339C
12	4:54857	*See* SAND-79-1325C
13	4:55757	*See* SAND-79-1333C
14	4:54707	*See* GEFR-SP-140
15	4:54863	Dep. NTIS, PC A02/MF A01
16	4:54260	*See* BNL-26331
17	4:54213	Dep. NTIS, PC A02/MF A01
18(Summ.)	4:54882	Dep. NTIS, PC A02/MF A01
19	4:54883	Dep. NTIS, PC A02/MF A01
20	4:55868	Dep. NTIS, PC A02/MF A01
21	4:55374	*See* SAND-79-1404C
22(Summ.)	4:54884	Dep. NTIS, PC A02/MF A01
24	4:54202	Dep. NTIS, PC A02/MF A01
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28(Summ)	4:54888	Dep. NTIS, PC A02/MF A01
29(Summ)	4:54889	Dep. NTIS, PC A02/MF A01
30	4:54653	Dep. NTIS, PC A02/MF A01
CONF-791104-	(1. international micro and mini computer conference and exposition, Houston, TX, USA, 14-16 Nov 1979)	
1	4:55903	*See* EGG-1183-5107
CONF-791108-	(72. AICHE meeting, San Francisco, CA, USA, 25-29 Nov 1979)	
1	4:54070	*See* LA-UR-79-2041
2	4:54042	*See* UCRL-81934
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2156-1	4:55158	Dep. NTIS, PC A12/MF A01
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78-70	4:54679	Dep. NTIS (US Sales Only), PC A06/MF A01
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22-SA	4:54439	New Mexico Energy Inst., Las Cruces, NM
26	4:54513	New Mexico Inst. of Mining and Technology, Socorro, NM
27	4:54583	Univ. of New Mexico, Albuquerque, NM
31	4:54471	New Mexico Energy Inst., P.O. Box 3EI, Las Cruces, New Mexico
NP-		
23870	4:54470	The Publisher, 7283 Engineer Road, Suite G, San Diego, CA
23877	4:54588	California Energy Commission, 1111 Howe Ave., Sacramento, CA
23878	4:54105	Dep. NTIS (US Sales Only), PC A02/MF A01
23881	4:54132	Dep. NTIS (US Sales Only), PC A02/MF A01
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23903	4:55157	Sacramento, CA; California Energy Commission (1979).
23930	4:55051	Environmental Protection Agency, Cincinnati, OH
23935	4:55163	Dep. NTIS, PC A04/MF A01
23941	4:54294	Honolulu, HI; Department of Planning and Economic Development (1978).
23942	4:55535	Office of Coastal Zone Management, Trenton, NJ
23970	4:54514	NTIS
23972	4:55084	Lyndon B. Johnson School of Public Affairs, Austin, TX
23975	4:55115	West Lafayette, IN; Purdue University (1978).
23987	4:54063	Morgantown, WV; West Virginia University (1978).
23996	4:55057	TIC
NUREG-		
0533	4:54991	NTIS
0578	4:54992	NTIS
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